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THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 25th of each month.

BELOW we publish the second of the letters which are contributed by the editorial writers for THE BRICKBUILDER, the purpose being, as stated in the June number, to give the ideas of their authors as to the brick now in the market and to indicate the kind of material for which there is an increasing demand.

The writers are architects of the highest professional standing, and these letters should, as they no doubt will, receive the closest attention of the leading manufacturers.

In connection with these letters we should be glad to publish others from the manufacturers, as they unquestionably have their arguments to present to the architect.

COLORED BRICKS.

Some years ago brickwork as a possible substitute for stone in buildings of importance came to the front, and after many years of disrepute brick again came to be considered as a suitable material for the better class of work. Following on this movement came a great increase in the production of bricks of varied color. Hitherto, brick manufacturers, following the demands of the market, had been producing a very accurate and smooth red brick, which, laid up with a fine red joint, was, perhaps, suitable for certain places and certain kinds of work, but was not worthy of the general use to which it was put.

The introduction of the colored brick was a movement of much promise, but color in the hands of the inexperienced is a dangerous thing, and we find now on every hand, side by side with the good work, examples of colors raw, crude, and inharmonious, as far removed from the good examples as the common Romanesque of to-day is from the work of Richardson.

After these two experiments, first in pressed red and then in colored brick, we have noticed a tendency to return more or less to the common red brick as a material at once economical and safe, and, while it can never offer the opportunities which varied colors give, it has, at least, varied shades of color, and that a color which is first rate for exterior work. The history of architecture gives ample authority for the general use of common red brick. Of the various countries which are notable for their architecture, Italy, Holland, and England give us, perhaps, the best precedent for its use. In Italy we have the splendid remains of Roman brickwork and the later brickwork of the Renaissance period. In Holland we find whole cities built of brick, — houses, shops, warehouses, and even public buildings and churches; and in England it would be hard to find any more lovely and typical examples of what is good in architecture than the old red brick houses such as are scattered throughout the land. Now, the brickwork of these countries covers a wide field, and yet it was largely common red brick.

There is, however, one thing about the brick itself which is of vital and prime importance, and which is generally overlooked here. English, Dutch, French, German,— in fact, all brick except ours, — are made of a fixed proportion. The thickness may vary, and we may have four courses to the foot, or seven, or eight, but the length and width are always in strict proportion. Two headers and a joint make one stretcher.

This fixed proportion enables the continental mason to lay up his brick with considerable variety of bond, and yet keep uniformity and have his joints true and plumb; it enables him to make diapers of many designs and keep them regular without ever cutting a brick, and, more than all this, it teaches the mason at the outset how important bond is, and how vital a member of the whole is the individual brick. Once grant that the individual brick is important, and one will not be led into the error of attempting by a fine joint, connecting perfect lines and arrises, to conceal this individuality, and make the whole wall seem like a uniform painted surface.

The common brick is, then, a really important and worthy member of the company of building materials, and we may cite in support of this, from numberless examples, Holland House in London and the Tower of St. Albans, the Waag at Amsterdam and the church at Dordrecht, the church of the Frari in Venice, and Santa Maria's Tower in Rome; and, in our own country, the Virginian Westover, or the church at Alexandria. We are surely in good company when we build of common red brick.

And now as to fancy brick,— pressed red or colored brick. It is true that the better the material the better the result should be, but we think that in architecture, as in all other arts, the workmanship is of far more importance than the material, and better material justifies its existence only when it is the vehicle to show better workmanship. First and foremost, the workmanship ought to be honest and true, and then it may be as finished and as perfect as it can be made. Now, a common brick wall faced with four inches of fancy brick, which are not the same size as the backing, and which, if bonded at all, have merely a blind bond, is not true construction, and no amount of money laid out on the face brick or of skill displayed in the pointing will justify this false construction. But if the more perfect

brick are honestly laid, and by their accuracy enable the thorough workman to keep his joints perfectly horizontal, of even widths, and perfectly plumb, then the material justifies itself, and the workman may feel proud of the work of his hands, for, with his fine material, he has accomplished what he could not have done with irregular, common brick.

The same course of reasoning applies to colored brick, though in a somewhat different way; the use of color must be justified by the knowledge and color sense of the designer. If he has not a color sense, and is satisfied merely to specify "yellow" brick, as he might specify "first quality limestone," and never troubles himself to select the yellow which will harmonize with stone or other materials, he proves himself unworthy of his material.

Given perfect brick, of almost any color, thorough workmen, and a skilled designer understanding the material and the use of color, and there would seem to be no material more worthy of honorable use for any kind of building whatever than brick. It is a product of man's hand, and may show the skill of the brickmaker, in making a block perfect in proportion and true in line; the skill of the chemist in combining various clays to produce various colors; the skill of the mason in laying his brick in due order; and, finally, the skill of the architect who, as a true master builder, grasps all the possibilities of the material which he finds at his hand.

R. C. S.

RESULTS OF THE CITY HOUSE COMPETITION.

Messrs. H. Langford Warren, C. Howard Walker, and C. H. Blackall, who acted as judges in The Brickbuilder Competition for a City House, the front of which was to be of brick and terra-cotta, cost not to exceed $16,000, have made the following awards:

First prize, $60, Edwin R. Clark, Lowell, Mass. Second prize, $40, Edward E. Hendrickson, West Philadelphia, Pa. Third prize, $20, Thomas Wight, Linden, Union County, N. J.

Those receiving special mention are: Will S. Aldrich, Boston, Mass.; Lewis Stewart, Trenton, N. J.; H. G. Fletcher, Boston, Mass.; James Webster, Boston, Mass.

There still remains to be judged the specifications for constructing a similar house so that it will be fire-proof. At the time of going to press we have not received the committees' full report on the competition, and as a consequence we are obliged to postpone the publishing of same until the August number, at which time the successful designs will be published, also.

We request the privilege of keeping the drawings submitted in the Competition until plates shall have been made from them, after which they will be returned to their owners, all charges prepaid.

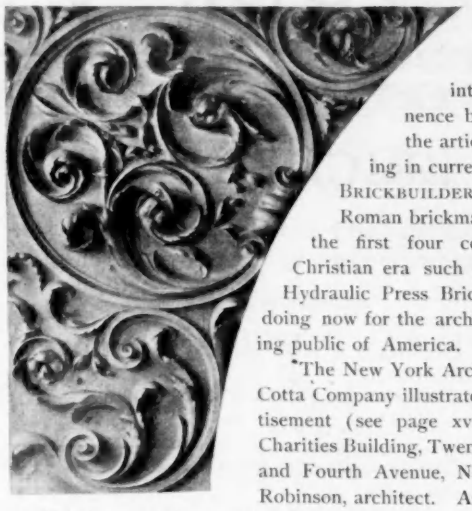
COMPETITION.

We are authorized by the New York Architectural Terra-Cotta Company to announce a competition for the best design for a full-page advertisement to be used in The Brickbuilder. The drawings must be made in line with black ink on sheets cut to the uniform size of 14 by 18 inches. For the best designs there is offered a first prize of $50, a second prize of $25, a third prize of $15, and a fourth prize of $10. The prizes will be awarded by a jury of three architects of acknowledged reputation. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked containing the full name and address of the designer must accompany the drawing. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of the New York Architectural Terra-Cotta Company. The Brickbuilder reserves the right to publish the successful designs. Other drawings, at the conclusion of the competition, will be returned to the competitors. Drawings must be delivered flat, express or postage prepaid, at the office of The Brickbuilder not later than October 1.

OUR ILLUSTRATED ADVERTISEMENTS.

The subject for this month's illustration in the advertisement of the Hydraulic Press Brick Company (see page xix) is a portion of the Campanile of Chiaravalle.

The important part which brick, as a building material, has played in mediæval architecture has been brought into due prominence by Mr. Cusack in the articles now appearing in current issues of The Brickbuilder. What the Roman brickmakers did during the first four centuries of the Christian era such concerns as the Hydraulic Press Brick Company are doing now for the architects and building public of America.



The New York Architectural Terra-Cotta Company illustrate in their advertisement (see page xviii) the United Charities Building, Twenty-Second Street and Fourth Avenue, New York, R. H. Robinson, architect. As we have not in hand at this time photographs of the details used in this building, we publish instead a panel and capital executed by this company for the new office building on Broadway, New York, [for] John T. Williams, Esq.

The ever-welcome *Review of Reviews* comes to our table for July laden, as usual, with the more interesting events gathered from the records of the world's daily doings, and put into such concise form that "he who runs may read."

With the August number we shall commence publishing the measured drawings of Italian brickwork, by Mr. C. H. Alden, Jr., as announced in our prospectus for 1895. In all there are twelve of these drawings, which are of a most interesting character,—one of which will be published each month.

Hugh Todd, architect, has entered into partnership with J. F. Walker. Address Todd & Walker, Los Angeles, Cal.

F. A. Gutterson, architect, formerly with Ernest Flagg, has formed a co-partnership with F. W. Kinney, and opened offices in Mason City, Iowa. They would be pleased to receive catalogues and samples.

The American Terra-Cotta and Ceramic Company, of Chicago, of which W. D. Gates is president, has removed its offices from Manhattan Building to the new Marquette Building, corner Dearborn and Adams Streets.

PLATE ILLUSTRATIONS.

THE plate illustrations for this month consist entirely of the work of Shepley, Rutan & Coolidge.

CONANT HALL, HARVARD COLLEGE, is a four-story dormitory, containing forty-four suites of two rooms each, three single rooms, and a janitor's room, also bathrooms and lavatories on each story.

The exterior of the building is built of hard-burned, rough brick, laid in Flemish bond with dark headers, the cement joints rather a light color. There is a granite plinth next the ground and a projecting base course, in which the cellar windows occur, about 4 ft. high. The top of the base course is molded rough brick.

The first story is brick rusticated work, every sixth course being recessed and composed of dark headers. The arch of the main doorway is constructed in the same manner.

The string-course at the second-story level and the balcony over the front entrance are buff Amherst stone, also the string-course at the height of the fourth story and the tablet with the inscription. The second-story staircase window is a large arch, the voussoirs projecting slightly from the surface of the wall. All the windows have flat arches of brick molded to suit the radius of the arch.

HOUSE FOR MR. JOSEPH H. WHITE is built of hard-burned, rough brick, laid in Flemish bond with dark headers, with gray terra-cotta trimmings, the terra-cotta having a surface similar to crandalled stone. All the sills, jambs, and lintels of the windows; copings of gables, walls, and chimneys; the arches and columns of loggia, balustrades, front wall, and gate posts are of gray terra-cotta, furnished by the Perth Amboy Terra-Cotta Co. In the balustrade of the terrace, which is made of brickwork with a terra-cotta capping, glazed, modeled, pottery tiles of a greenish-blue color, which are imported from China, are inserted in the panels.

BUSHNELL BUILDING, AN OFFICE BUILDING IN SPRINGFIELD, OHIO. The first story is of Kibbe stone; the remainder is of Roman brick of a rust color with gray terra-cotta trimmings. The cornice is entirely of terra-cotta. The brick are made by Harbison & Walker of Pittsburgh, and the terra-cotta by the Northwestern Terra-Cotta Co.

HOUSE FOR WM. DICKENSON, ESQ., IN CHICAGO, ILL., is built of buff brick with buff terra-cotta trimmings. The cornice and balustrade are of terra-cotta. The basement and the entrance porch are of limestone. The brick are made by the Hydraulic Press Brick Co., and the terra-cotta by the Northwestern Terra-Cotta Co.

The house in Washington is of light-gray brick and all the trimmings are light-gray terra-cotta above the first story. The first story is of gray limestone.

MR. WM. CONNORS, Troy, N. Y., the well-known manufacturer of "American Seal" Mortar, Stains, and Roofing Cement, authorizes us to announce a competition for the best design for an advertisement to be used in THE BRICKBUILDER. The wording which is to be incorporated in the design may be found in Mr. Connor's advertisement for this month on page xxv.

The drawings must be made in line with black ink on sheets cut to the uniform size of 4 by 11 in. Each drawing must be marked with a motto or cipher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made. The designs for which prizes are awarded will become the property of Mr. Connors.

For the best design, there is offered a first prize of $25, a second prize of $15, and a third prize of $10.

The prizes will be awarded by a jury of three gentlemen competent to judge of this class of work.

Drawings must be delivered flat, express or postage prepaid, at the office of THE BRICKBUILDER, not later than October 1.

THERE were fifty-three sets of drawings submitted in the City House Competition, coming from all parts of the United States.

BRICK AND MARBLE IN THE MIDDLE AGES.

G. EDMUND STREET.

CHAPTER VIII. — *Continued.*

WE cannot do better than take as an example of the finest type of a Byzantine palace the magnificent, though now desolate, decaying, and ruined façade of the Fondaco de' Turchi, once the palace of the Dukes of Ferrara. The whole front of this was originally cased with a thin facing of marble, like the coeval works at St. Mark's,— a kind of decoration which, neglected as this fine relic has been for years, we cannot be surprised to find almost altogether destroyed; small fragments do, however, still here and there remain to tell of the original magnificence of the work. The lower stage of the Fondaco consists of a continuous arcade of ten open arches, with three narrower arches at either end, forming the wings, so to speak; the upper stage has eighteen arches in the center and four in each wing. In the wings the piers supporting the arches are, I think, all molded pilasters; in the center all the arches rest upon columns; and throughout the whole building the arches, which are all semicircular, are considerably stilted. The entire building is constructed in brick, which was originally, as I have before said, covered all over with a thin veneer of marble; in the spandrels of all the arches this is relieved by small circular medallions, delicately carved, and over the upper stage is a string-course, above which there would seem to have been a long series of slightly sunk panels with round-arched heads, filled in with delicately arranged and beautifully sculptured patterns in marble. These panels are immediately below the eaves of the roof. Many of the abaci and string-courses and all the thin pieces of marble which form the soffeits of the arches have their projections finished either with a nail-head or dentil molding, and between the shafts of the upper stage there are traces of balconies.[1]

A very noticeable point in the general effect of the façade of the Fondaco de' Turchi is that, from the peculiar shape and great projection of the capitals of the shafts and the narrow span of the arches, the whole of the arcading has, at a small distance, almost the effect of a series of trefoils, and so seems to pave the way for the continuous traceries of the Ducal Palace and other later buildings.

There is a ruined fragment of a house of the same age as the Fondaco de' Turchi in a canal behind the Foscari Palace. Here the center arch is very wide, has four stilted arches on the sides, the archivolts are all delicately carved, and small sculptured medallions are introduced in the spandrels. Here, I think, the red brick of the walls was always intended to be seen. Of very similar character is a much larger fragment on the right of the Grand Canal after passing under the Rialto. Here there are two stories still remaining. The round-arched doorway has two open and stilted arches on each side, and then a space of blank wall; and the upper stage has a group of seven arches in the center and a single arch at each end over the blank wall below. The labels of these upper arches are turned up at the point into an ogee shape, which, strange as it may seem, must be original, as the detail is early, and they are surmounted by a collection of carved medallions and a carved string-course of early style.[2]

The Ca' Loredan has two stages in height, above which all is modern; but all the Byzantine arrangements of these two stages are perfect. There are five open arches in the center and an arcaded pier on each side; and in the next stage, though the division of center and wings is preserved, the arches are increased in number,

[1] I leave this description as it stood in 1855. Since then the whole of this interesting building has been so elaborately restored that I doubt whether an old stone remains. It has lost all its charm, and this was once intense.

[2] This house is in the Sestiere di Cannaregio, Parrochia San Canciano.

and, consequently, the columns of this stage do not come above those of the lower stage. The string-courses are formed with a billet mold; the capitals are some of them genuine Byzantine, and some copies of Corinthian. The wall-faces were all inlaid, but they were in part altered in the fourteenth century, when some coats-of-arms and figures were added. Those at the extreme angles are of David and Goliath, and on each side of the center, sitting figures of Justice and Force.

Next to the Ca' Loredan is the Ca' Farsetti (now the Municipio), which is, I think, slightly the older building of the two. Here there are three arches resting on shafts in the center, and an equal number resting on piers on each side, and a continuous arcade of fifteen arches on the upper stage resting on coupled shafts.

The Palazzo Businetto on the Grand Canal opposite the Ca' Grimani has remains of Byzantine work in its two lower stages. Here the caps are Byzantine in character, the archivolts flat inlays, with a billet mold on each side, and a carved string-course of running foliage enclosed between two lines of notched or billet mold.

This short notice of some of the more important Romanesque and Byzantine remains enables me to make a few general deductions: (1) These buildings were always of two stages in height. (2) They had the entrance in the center, and had, generally, a distinction between the center and the wings. (3) The capitals were generally Byzantine in character, but often copied from Corinthian. (4) They were of brick, but generally veneered with thin slabs of marble. (5) They were enriched with circular, square, and arched medallions, enclosing carving of foliage and animals, and, frequently, of coupled birds or animals regarding each other, a device always indicative of an early date and an Eastern origin, — and (6) the string-courses were generally carved, either with continuous running foliage or with leaves arranged in threes, the center turning over, the side leaves extended flatwise and upward. This last string-course is exactly copied from Sta. Fosca, Torcello, and is carved all round St. Mark's inside, whilst the former, though it is Byzantine in origin, is carried round the wall of the Ducal Palace between the southeast angle and the Bridge of Sighs. The illustration of a Byzantine cistern from the center of a courtyard, which I give, is useful as showing very clearly the character of the carved foliage which adorns the string-courses and panels of these Byzantine buildings. This is always effectively carved with deep cuttings which produce bright and sparkling effects of light and shade.

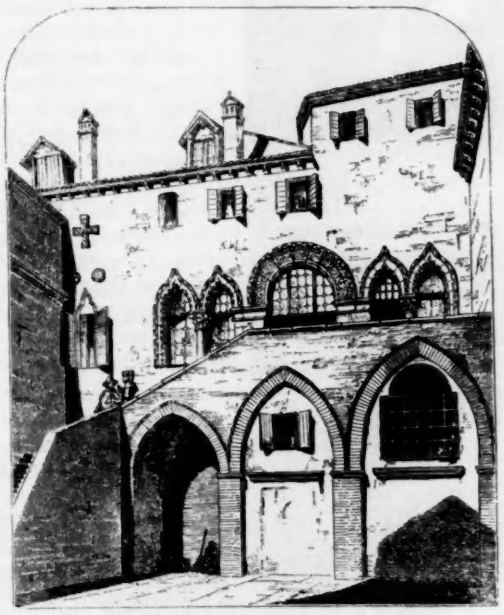
BYZANTINE WELL, VENICE.

One especial fault of the Venetians seems to have been their proneness to repeat the same architectural idea an infinite number of times; and there is something in this so characteristic of the place and the people that the reason for it is worthy of some consideration. Venice, surrounded by water, and cut off from that kind of emulation which, in other places, always has the effect of producing life and change very rapidly in the phases of art, seems to have contented herself when once she had well done with the conviction that improvement was either impossible or unnecessary; and so, whilst changes were going on in the mainland, to have rested satisfied with a slight alteration only, and that one of detail always, for centuries; and it is thus that I account for the singular sameness which characterized all the efforts of her Gothic artists. The façade of the Ducal Palace is really precisely the same in its idea as that of the Fondaco de' Turchi or the Ca' Loredan, altered only in detail, its very beautiful traceries taking the place of but doing the same work as the simple encrusted arcades of its predecessors. And again, in the fronts of other and much smaller palaces, — indeed, in all the fronts of the Gothic period, — it is singular how exactly the same idea in the general arrangement is always preserved. Let me describe an ordinary palace. It is divided into three or four stories in height, the several stages being generally separated by string-courses. The lower story opens, by an arched doorway in the center, to the water, and on either side of this doorway a few small windows serve to light the basement. The second stage has a grand window of some five or six lights, divided by shafts of marble, and rich with tracery in the center, and on either side one or two single lights with tracery corresponding with, and often, as it were, cut out in a slice from the traceries of the central window. The third stage is nearly a reproduction of the second, though sometimes slightly less important; and the upper stage is either again a repetition of the others, or else consists of a few small windows placed over the others, and very unimportant and unpretending. The whole is crowned by a slightly projecting eaves-cornice, generally very meager in its character, and with a line of genuine dog-tooth ornament on its lower edge. Above this, probably, — for only one or two examples remain at all in their original state, — was a parapet like those which still in part remain on the Ca' d' Oro, at the back of the Ca' Foscari, and on the Ducal Palace, light and fantastic to a degree, and almost masking the flat roof behind.

Such, as will be seen by the views with which, I doubt not, almost all my readers must be familiar, is the general idea of the Gothic palaces in Venice, and it admits of very slight modification. Occasionally, as in the Ca' d' Oro, the windows are enclosed within a square line of delicate molding, the space within which is encrusted

with marble and entirely distinct from the string-courses, so as to give very much the impression of a plain wall veneered here and there with a window; or, again, sometimes the whole central division of the first and second stories is veneered on to a façade in which the other windows are treated constructionally; but in all cases, from first to last (except, as we shall see, in the Ducal Palace, and for this exception there is some explanation in its vast size and other reasons), the distinction between the center and the wings was never lost sight of and never forgotten. This was the great idea of all these buildings, and most perseveringly was it reproduced down to the last, when, gradually losing even the life which beautiful detail had once lent, it sank through successive stages until, at last, easily and well-nigh imperceptibly, it succumbed, without a struggle, to the rise of the Renaissance feeling, giving only in revenge to its successor the curse of an obligation still to go on building to the last, for whatever want or on whatever occasion, with the conviction that a center and two wings must ever be necessary to a grand façade. It so happens that, in addition to the large and purely Byzantine palaces in which this arrangement is preserved,—in a delicate manner, it is true,—there still remains one remarkable example of the period of transition from Byzantine to Gothic, in a house which forms one side of the Corte del Remer (facing the Grand Canal just above the spot where it is spanned by the Rialto), which serves to show clearly the first attempt at translation of this Byzantine idea into Gothic.

In the principal story of this house the central feature is the entrance doorway, whose finely ornamented arch of markedly horse-



CORTE DEL REMER, VENICE.

shoe outline is very conspicuous. On either side of this, and connected with it in one group, are two windows divided by shafts and with arches of very singular shape; it is as though a stilted semicircular arch had been suddenly turned up in the center, not with the graceful ogee curve of later days, but with simple, hard, straight lines. Beyond these windows, one of later date, but probably inserted in the place of the original window, completes the similarity which the arrangement of the openings in this house bears to that common in all the later Gothic palaces. The arches which support the staircase in front of this house are entirely executed in brick, and are probably later in date than the house itself, though it is noticeable that they are of a very early and pure type, and that here, as generally throughout the north of Italy, the pointed arch was first used in construction, and then, some time after its first introduction, and very generally in some modified form, for ornamentation, also.

And now, having so far cleared the way, let me ask my readers to go with me to the Ducal Palace and there undertake a somewhat careful examination of its very famous design.

I shall not enter into a general description of the entire building, because, as this has undergone prodigious alterations since its first erection, it is unnecessary to do much more than refer to the two fronts which still retain, nearly without alteration, their mediæval design, and to those portions only of the interior and courtyard which have not been altered.

The whole building forms three sides of a hollow square: one side rises out of the deep recesses of the Rio del Palazzo, spanned near its outlet by the famous Bridge of Sighs, and is entirely of Renaissance work; the next side, rising from the Riva dei Schiavoni, faces the Giudecca, and is of the purest Venetian Gothic; and the third, facing the Piazzetta di San Marco—the small square which connects St. Mark's with the water—is also Gothic, and of the same type. The back or north side of the palace abuts upon St. Mark's.

I cannot pretend to decide at all absolutely upon the vexed question of the dates of the mediæval portions, because, as the reader will find in an interesting discussion on the subject in the second volume of Mr. Ruskin's "Stones of Venice," it is a source of hot disputes. But the following appear to me to be the main points.

The Ducal Palace was burnt in 1105, restored in 1116, and rebuilt in 1173–1177. The two columns on the Piazzetta were brought to Venice in 1172, about which time the two Piazze were formed. Between this date and 1301 nothing is recorded to have been done to the palace. But even at this date it was a grand building, and is described in 1275 by Maestro Martino da Canale as "Grande e bellissimo a maraviglia."[1] He was equally enthusiastic about the church of "Monsignore San Marco," and of his campanile, "so great and so high that one cannot find its equal." Sivos, in his chronicle (A. D. 1621), says that the Sala Grande was commenced in 1301 and completed in 1310, at which date the Grand Council consisted of nine hundred members; and one Pietro Baseggio is said to have been the architect between 1309 and 1361; he was succeeded or assisted by Filippo Calandario; and both of them, according to Zanotto, were described as being architects, sculptors, and navigators![2] Calandario had raised himself from the humble post of shipbuilder at Murano to that of Capo Maestro of the Ducal Palace, a man of great weight in the city, but finally finished his career only too much in accordance with custom, being convicted as one of Marino Falieri's fellow-conspirators, and hung from the balcony of the Ducal Palace in A. D. 1355.

On the 28th of December, 1340, a decree was issued ordering the construction of a staircase on the east side of the palace to lead to the new rooms, which seems to establish the fact that at this date a considerable portion, at any rate, of the second stage was built. The plague visited Venice in 1359 and 1361, and stopped all work. In 1362, because the unfinished work was going to ruin, the Council determined to complete the new hall; and in 1365, this being done, Guariento of Padua began to paint it in the time of the Doge Mario Cornaro.[3]

The capital next the southwest angle of the lower stage bears a date which appears to some[4] to be 1344 (as to which I have never been able to satisfy myself), and long afterwards we find the date, 1404, on the large window of the highest story of the sea-front. Finally, in 1419, there was a great fire, which damaged the old por-

[1] Zanotto, *Il Palazzo Ducale di Venezia*, i. 39.

[2] *Ibid.*, i. 52–60.

[3] 1362, *die iv. Dec. Quia est Magnus honor civitatis providere quod sala magna majoris consilii nova non vadat in tantum desolationem in quantam vadit cum notabili damno nostri communis: et sicut clare comprehendi potest, leviter potest compleri, et reduci ad terminum, quod satis bene stabit cum non magna quantitate pecunie; vadit pursquod dicta sala nova compleri debeat*, etc., etc. Decree in Zanotto, i. 72.

[4] Mr. Burges, in his account of the capitals, *Annales Archéologiques*, Vol. XVII. pp. 74–88.

tion of the building so much that a decree was passed to rebuild it in conformity with the rest, and this work was completed in 1423, when the council sat in their great Council Chamber for the first time; and in 1439–41 the last Gothic work was added to the palace by the Doge Foscari, viz., the Porta della Carta, built (as appears by their contract) by Giovanni and Bartolomeo Bons, between the years 1438 and 1443, in the small space which intervenes between the northwest angle of the Ducal Palace and the south side of St. Mark's. All these dates are important, and, I believe, undisputed, the only question being as to which parts of the building they refer to.

And now, before I say more about dates, let me describe these two Gothic fronts,—the sea-front and the Piazzetta-front,—and then we may, perhaps, see our way to some sort of comprehension of the relative ages of the various portions of the fabric.

The whole design is divided into three stages in height, the upper nearly equal to the united height of the two lower stages, and faced entirely with a delicate diaper of marble cut in small oblong pieces, which look, save in their texture and color, only too much like bricks. In this marble-faced wall are pierced a number of windows with pointed arches, the tracery of which has been taken out, and in or near the center of each façade a much larger window and balcony, which look as though they had been subsequently inserted. The lowest stage consists of a long and uniform arcade, of very simple pointed arches resting upon circular columns with elaborately carved caps; these have been shortened by some twenty inches of their old height by the rise of the water, and the consequent elevation of the pavement of the Riva, to the great damage of their effect. The intermediate stage is a magnificent arcade, supporting very vigorous tracery, too well known to everybody to require much description, and divided from the stages above and below it by large and pronounced lines of carved and molded string-courses.

PART OF THE CHURCH OF SANTI GIOVANNI PALO, WITH STATUE OF BARTOLOMEO COLLEONI, VENICE.

It is important to observe that up to the top of the second string-course the whole of the architecture is of the very best kind of Venetian pointed; the arches of the lowest stage are well proportioned, and, though very simply, still well molded; and the detail of the whole of the second stage is, to say the least, not at all inferior. They form together, without exception, I believe, from all I have either seen myself or heard, the very best and truest specimen of Gothic architecture south of the Alps.

Above this noble work the third stage comes, and I confess, to my eye, with patent marks in every stone of which it is composed, that it was designed by some other hand than that which had been so successful below. There is something quite chilling in the great waste of plain, unbroken wall coming above the extreme richness of the arcades which support it; and, moreover, this placing of the richer work below and the plainer above is so contrary not only to all ordinary cañons of architecture, but just as much to the ordinary practise of the Venetians, that I feel sure that the impression which I have had from my first acquaintance with drawings of it is substantially correct, viz., that the line at which alterations and additions have been made is to be looked for rather in a horizontal than in a vertical direction; that in all probability, consequently, the builder of A. D. 1301 commenced with some portion of the sea façade, and gradually carried on the greater part of the building to the height of the two stages as we now see them, leaving his building finished in precisely the same way as the corresponding halls at Padua and Vicenza, two stories in height, with arcades covering the outer walls of the upper as well as of the lower stage; and that when the Council Chamber was found to be too small, and larger rooms were required, another architect suggested the advantage of obtaining them by raising an immense story above the others, and, without destroying much of his predecessor's work, providing rooms on the most magnificent scale for the Doge and his council.

(*To be continued.*)

An architect's tools, to speak in the widest sense, are men. He must be able to inspire confidence, must learn to persuade his fellows, otherwise he cannot have opportunity to express his artistic impulse; but more than this, he must be able to command respect from his helpers, those intelligent tools so necessary to the production of his works. The wider his education on general lines, therefore, the better for him, as for all who find it necessary to deal with men diplomatically.—Henry Rutgers Marshall in *Architectural Record.*

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART II.

CUT STONE MASONRY AND ROMAN FRAMING.

FIRST CHAPTER.

GENERAL METHODS OF CUT STONE CONSTRUCTION.

IN studying constructions of concrete the methods used seem to have arisen from one single principle, for the thought of economy dominates them all and gives them a remarkable unity. The study of construction with cut stone will not leave the same simple impression. In buildings of concrete any construction that did not interfere with strength was admissible, for it was to be hidden by the revetment; here, on the contrary, the conventions of decoration were added to the exigencies of the art of building,—a first complication. Then there was the influence of custom, for the Romans had never entirely lost the tradition of the use of colossal stones, which had been handed down to them from the ancient inhabitants of Italy. Yet they used this form of construction with reserve, and their aim was more to make an impression by the grandeur of their conceptions and the wise simplicity of their methods than by showing the difficulties they had overcome. The Greek architects had preceded them in this direction; and so long as it sufficed to follow those masters, the builders of Rome avoided useless and imprudent innovations. Their methods of cutting and using stone were, for the greater part, those of the Greeks; it is therefore necessary, in order to understand them fully, to study them first in the architecture of the Greeks themselves. We will do this by taking up, as an example, the unfinished colonnade of the Temple of Segestum (Plate XXIII.).

One sees, at the first glance given to this ruin, a number of more or less irregular projections on the stones, which are so many indications of the methods followed in preparing and setting the materials of the edifice. These projections are cubes, N, at the angles of the blocks of the stylobate; ridges, such as A and D, along the joints

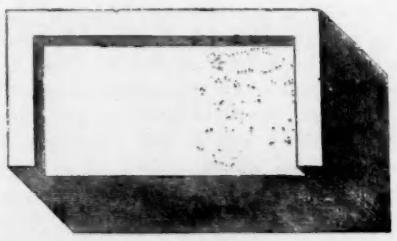


FIG. 59.

between the stones of the architrave; vertical prisms, B, along the arrises of the abacus, etc.

What was the object of these projections? Are we to regard them as preliminary to decoration or were they a means of protecting the corners, the angles, or the faces of the stones until they were set? Both of these reasons have a place in a full explanation of the remarkable roughing-out that we are examining; but the second has, I think, the greater importance. The salient cubes, N, left at the angles of the stones of the stylobate, degenerated, during the Roman period, to long prisms, such as those in Fig. 59, which is from the portico of the so-called Agora in Athens. There the projections were evidently not simply decorative; and their role was the same in the monuments of the primitive Grecian art; such as N, (Plate XXIII.), they served to protect the stone, and according as they were damaged or remained intact, they could be removed or converted into ornament when the edifice was completed.

During the first centuries of Grecian art it was not customary to preserve the projections; they were left in cutting the stone only for their usefulness, and when they were no longer needed for protection it was only natural to remove them. Later, when the care given to construction became less, when the protection of the angles became a useless precaution in the view of the incorrections to be found in all parts of the edifices, the Greeks still cut the cubes and prisms in relief on the angles of the stones, but they then did it simply for ornament, and commenced to decorate them with moldings. The Theater of Bacchus affords some examples of this transformation, and I have tried to characterize, by exaggerating, the appearance of some of the stones found in the ruins of this interesting edifice (Fig. 60).

On examining the stones of the architrave of Segestum, we will find that they give rise to the same remarks as the unfinished stones

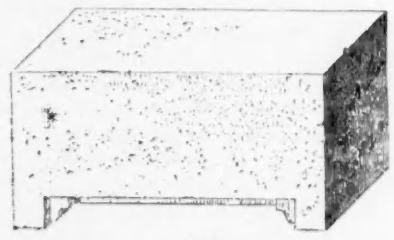


FIG. 60.

of the stylobate. It is clear that the ridges A and D (Plate XXIII.)[1] were not decorations; they form a border everywhere that the stones come into contact, and this circumstance is indication enough of their origin: they were intended to prevent the two sharp arrises from chipping when the faces of the joints were brought in together.

Such, also, is the explanation which must be given for the ridges A and D which border the vertical joints of the architrave. These ridges had been already partially removed when the construction was interrupted, and it is shown by this that it was from the exterior face that the workmen first removed the projections. As soon as the stones were in place — in other words, as soon as there was no longer anything to fear from shocks resulting from the meeting of the heavy blocks — they hastened to remove this excess of material which no longer had a reason for existence. Such methods of protecting the joints would have been superfluous if a bed of mortar had been put between the stones, for such a cushion would have diminished the effect of a sudden contact; but with dry joints, the shocks might cause considerable damage to the angles, which the ridges would prevent.

Similarly, the long, nearly rectangular prisms B, on the vertical angles of the abacii at Segestum, were not ornaments which were to remain when the edifice was completed, but were plainly a means of protection for the angles of the capitals, whose great projection exposed them to breakage.

Furthermore, the projections at the centers of the stones of the stylobate served, above all, to protect these faces from damage; afterwards, these, as well as the cubes N at the angles, could be done away with or kept as ornaments, according to circumstances. Projections of the same kind were probably left on all the stones of the pediment, and were cut down at the same time as the ridges A along the joints of the architrave; but on the inner face of the pediment they were left intact, and the stones are to-day to be seen in the same condition as when they were set.

[1] The prisms, D, were noticed for the first time, I believe, in the unfortunately scarce plates of the magnificent work which M. Hittorff commenced on the ancient monuments of Sicily.

Finally, when it came to the columns, the ancients dressed only the upper and lower beds of the drums in the yards, the vertical faces being left rough; the flutes were only started at the top of the upper drum and at the bottom of the lower, and the final shape was given to the columns when the stones were in place. Such are, in particular, the columns of the unfinished temple, believed to be the ancient Parthenon of Pisistratides, whose debris decorates the southern wall of the Acropolis of Athens; these columns were in the state we have just described when the invasion of the Persians stopped the work.

Later, as we have said, this preparatory work was left visible, and it is to be questioned whether this was from motives of economy or of esthetics. At least, it is certain that the Greeks had no aversion to these so-called temporary forms; they waited before dressing the shafts until all the other parts of the edifice were completed; they commenced the dressing at the upper parts of the building, descending from the cornice to the lower members of the entablature, and then to the capitals; and it was only after these were completed that they carved in the shafts of the columns the traditional flutes. But often, regarding this last refinement as superfluous, they left the columns in their unfinished state; it was thus at the great temple of Eleusis, at the Portico of Thoricus, at one of the temples of Rhamnus, in the ruins of Delos, etc.[1]

If, from the works where art plays a large part, we pass to those of more facile construction, where the absence of curved surfaces would seem to allow more elementary methods, we will find that, while these are simplified, they are still the same.

If it was a question of building a straight wall, the Greeks, in the edifices built with care, did not set the stones entirely dressed; the beds and joints only were finished beforehand, and the faces, if not entirely rough, were at least but very summarily prepared. The whole surface was dressed in a general finishing, and this, the last operation, could be done without risk of mistake and without hesitation, because before setting the stones they took care to cut draught-lines which plainly indicated the planes of the surfaces.

This system is manifest in the unfinished works of the south wing of the Propyleæ of Athens (Fig. 61). The irregularity of the surfaces shows that the present face of the walls was only temporary; the guiding lines frame each stone, or, more correctly, follow the re-

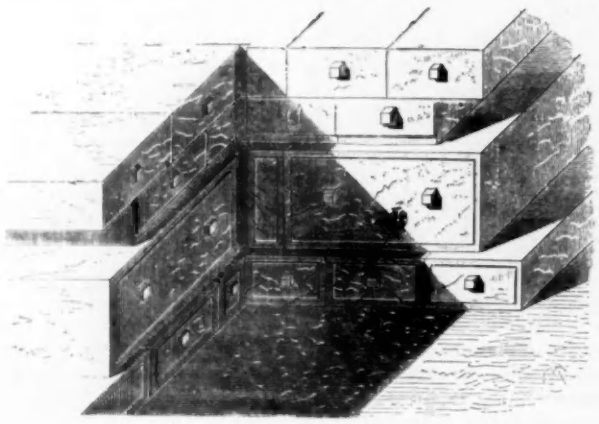


FIG. 61.

entrant angles; all the rest was to have been afterwards cut down and reduced to the uniformity of the completed parts of the edifice. In a word, the Greeks proceeded in preparing the face of a wall as in cutting the flutes of a column; grooves previously prepared served in both cases to guide the chisel in the delicate operations of the final dressing of the surfaces.

If, on the other hand, they wished to avoid the expense and delay of the dressing in place of the preceding operations, not being able to obtain an exact accordance between the different courses, they frankly broke the continuity of the surfaces and laid each course slightly in retreat on the one below it. Thus were executed the undressed walls of the Acropolis of Athens, those of the fortifications of the Pireæ, etc. The last are worthy of special attention, for they show a new manifestation of the tendency to transform into decoration that which originally was only a practical expedient. The sunken frames, which in the Propyleæ (Fig. 61) served only to make the dressing more certain and rapid, have the appearance of panels in the walls, where the stones are still as they were when set. Before, these frames, soberly distributed, bordered the large portions of the walls; here they have multiplied and degenerated into deep grooves along the angles of the stones.

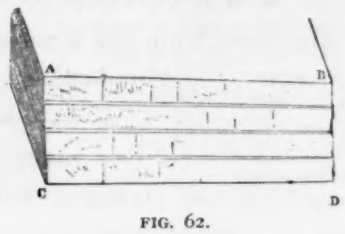


FIG. 62.

The Greeks had a more usual custom of leaving in the center of each stone a projecting tenon, R (Plate XXIII.); these tenons were of assistance in moving the stones or they served to show the amount of stone removed in dressing; they were either for raising the stones[1] or to show the amount due to the workmen for cutting. Even these projections were transformed into ornaments in the hands of the Grecian architects. In the Propyleæ (Fig. 61) they were to have been removed, and also at Segestum (Plate XXIII.) they seemed to have been intended to have only a temporary existence; but in the walls of the Pireæ (Fig. 63) one can see them used as ornament, and it must be acknowledged that their projections, combined with the retreating courses, give to the walls an extreme elegance.

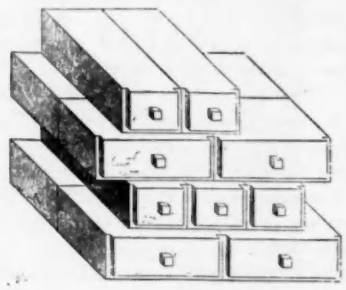


FIG. 63.

(*To be continued.*)

IT seems to me that students should be led to use perspective methods naturally; should be taught to *sketch* out their *projects* in perspective, and then to translate them accurately in terms of such geometrical projections as are needed by the practical workman. This, it will be noted, would be reversing the general method of study. In fact, we should lead the student to think of his building always as it is to be seen, and only secondarily as it is to be made to appear to his mechanical helpers; otherwise we are not teaching architectural design at all, but mere decorative composition upon plane surfaces.

There is this difficulty with the study in perspective, viz.: that we gain but one point of view for each drawing, and the architect will feel himself very unfortunate if the opportunities to view his completed building should be so restricted in fact. We may avoid this difficulty by the making of many perspectives, but more simply and satisfactorily by sketching in the solid, — by making models in clay or wax, or, at times, in paper. — HENRY RUTGERS MARSHALL in *Architectural Record.*

[1] For these last examples, see Stuart & Revett on the Antiquities of Athens; and for the fragments from the old Parthenon, Penrose's "Investigation of the Principles of Athenian Architecture."

[1] There are cases when there is no doubt that the projecting tenons were for moving the stones, as in the cases of the slabs used to cover the ancient sarcophagi. Each served as a sort of a handle in shifting the stone and, in fact, it was so easy to shift them by this means that the precaution was often taken of removing the tenons, in order to guard against a too facile violation of the tombs. But ordinarily the tenons were only to show the amount of stone cut off,—this was their principal purpose, for they are often to be seen in stones with lewis holes in them.

ARCHITECTURAL TERRA-COTTA.

BY THOMAS CUSACK.

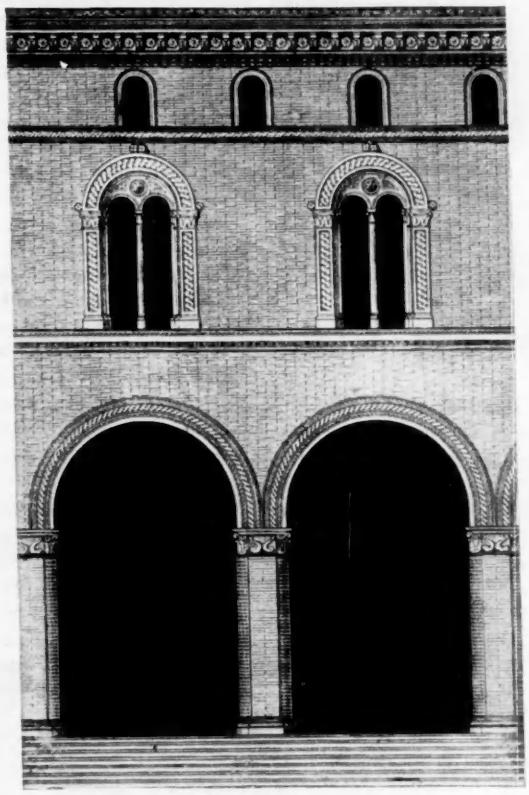
(*Continued.*)

"Let others better mold the running mass
Of metals, and inform the breathing brass,
And soften into flesh a marble face,
Plead better at the bar; describe the skies
And when the stars descend and when they rise;
But Rome! 'tis thine alone with awful sway
To rule mankind and make the world obey."

VIRGIL wrote Virgil, a great poet, and, for aught we know, "an honorable man," to whom let us hope that Dryden did full justice in this translation. If so, the tuneful Roman of the Augustan Age was lacking in architectural knowledge and appreciation, else he would not have allowed the man-compelling instincts of his countrymen to eclipse their far more meritorious and enduring achievements. His view point may have been too close; hence, the distorted perspective. A vista of two thousand years with the Pantheon in the distance would have enabled him to draw a more satisfactory picture. Rulers of men the Romans undoubtedly were, which to some people would, perhaps, account for their success as brick-makers (after the manner of the Egyptians), if not for their acknowledged excellence in the still more important art of using bricks aright in building. But it is enough for present purposes to know that these industrial arts spread with their conquests, and became known throughout their colonies and dependencies, which at one time extended from the Danube to the land of Cleopatra, and from the Caspian Sea to the Bay of Biscay, thence northward through Gallia, and westward to the white cliffs of Albion. The Roman legions carried war and bloodshed over this vast territory, it is true, but they left behind them other and more beneficent marks of human enterprise. To them, not Italy alone, but all Europe is indebted for examples in road-making, and for whatever there is of a civilizing influence in a good architectural use of bricks and mortar. America is just now discharging its share of this indebtedness by vigorously following their example.

TERRA-COTTA CHENEAU.
Dug up in the Campagna, Rome.

They may have been lacking in the grace and refinement of the Greeks, which had become effete, but for this they made ample recompense, in the utilitarian character of all their projects and the practical way in which these were executed, using for that purpose the material most readily to hand, and evolving a style suitable for its employment. In the solid and scientific use of brick they have never yet been surpassed. Hope in his "Historical Essay on Architecture" claims for them a highly artistic use of this material, and adds: "Far from considering brick as a material fit only for the coarsest and most indispensable groundwork of architecture, they regarded it as equally adapted for all the elegancies of ornamental form, all the details of rich architraves, capitals, friezes, cornices, and other embellishments." The use of brick so inaugurated has never been discountenanced or discarded in Italy, and it is to that country



PALACE OF FABBIA, BOLOGNA.

that we still look for inspiration in the architectural employment of clay products. In speaking of the Farnese palace, begun by Bramante and finished by Michael Angelo, the same writer remarks on the excellence of its brickwork: "The plain surfaces are of brick, so fine in its texture and so neat in its joints that by the superficial observer it is generally taken for stone," which recalls a more recent case where history repeated itself in New York City. And in the estimation of so discriminating a critic as Gwilt, we have it on record that "the palaces of Rome are among the finest in Europe, and of those in Rome none equals the Farnese."

Of all the wonderful erections that came into existence from the subjugation of Greece to the coming of Attila, some were demolished by the vandals, and some, it must be confessed, as ruthlessly despoiled by the "pious founders" of Christian basilicas, who, not only availing themselves of temples erected to the gods, did not scruple to carry some away piecemeal as building material. Most of them, however, had been too honestly put together to be easily taken apart, for, though the work of pagans, it could not well have been more thorough if done by Puritans. A goodly portion survived successive wars, mutinies, and invasions, with recurring lapses into barbarism, down through the Dark Ages. And when with the eleventh century came the first dawn of a revival in the Arts, the then existing works of the Cæsars furnished needful lessons in the principles of construction,

according to the availability of material, and examples on which were founded mediæval and modern styles of architecture.

In Lombardy, where stone was scarce and clay abundant, brick became well-nigh universal; and by a natural process of evolution blocks of a larger size, and of a constructive, as well as an ornamental character, were molded to required section from a finer grade of the same material, and used very much as stone would have been. Water tables, jambs, and cornice courses soon became available and were set as masonry, along with the red brick of the district, in the Romanesque church of Santa Euphemia at Pavia, erected in the eleventh century. The mediæval brick and terra-cotta thus introduced in the valley of the Po, developed into a some what provincial style, which has been termed Lombardo Byzantine. In this style, some very marvelous feats of construction, as well as of elaborate design, were executed throughout Northern Italy from the twelfth to the sixteenth century. The walling was of brick, and the more important architectural features, as well as the ornamental detail of the interior, were of terra-cotta. To this class belongs the Abbey of Chiaravalle, dating from 1221, with its octagonal campanile starting from a square tower, diminishing in four well-proportioned stages, and pointed with a brick-constructed cone, whose apex rises to a height of 200 ft., and into which the terra-cotta roofing is incorporated. To the same style may be assigned San Gottardo in Milan, with another lofty tower and conical roof. Very little stone was used in this "great country of brick" in any of the ecclesiastical structures of the time, and such as was interspersed, as a means of obtaining contrast and relief from the rich, but perhaps too prevalent red of the neighborhood, has suffered by comparison with the adjoining blocks of hard, close-grained terra-cotta. In some instances, as in San Gottardo, stone was used presumably as a protection to the terra-cotta; but if Majister Franscescuo-de-Pecoraris had lived, say, five hundred years longer, he would have been converted from his skepticism in regard to the time-defying qualities of burned clay. It is the stone, and not the terra-cotta, that has suffered from the prolonged stress of wind and weather. Mr. Ottolini, writing from Milan in 1867, says, "During five centuries this tower has braved the inclemency of the seasons without incurring noticeable traces of decay, although it has not been repaired for so long a time that weeds grow freely upon it."

TERRA-COTTA CHENEAU FROM POMPEII.

FROM POMPEII.

(*To be continued.*)

THE Seventh Annual Competition for the Robert Clark Testimonials, open to architectural draughtsmen under thirty years of age, residents of the United States, not practising architects, will be held under the auspices of the Chicago Architectural Club. Subject, An Art School.

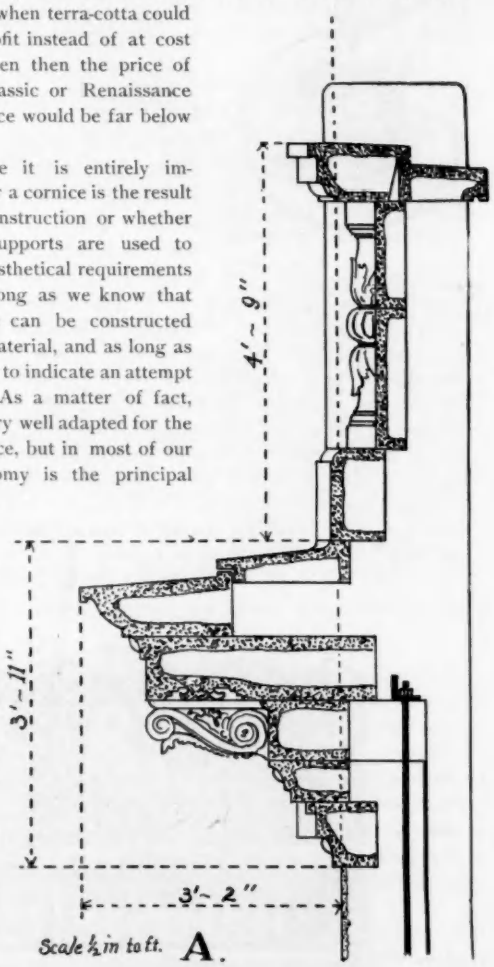
TERRA-COTTA FRAGMENTS.

BY FRITZ WAGNER.

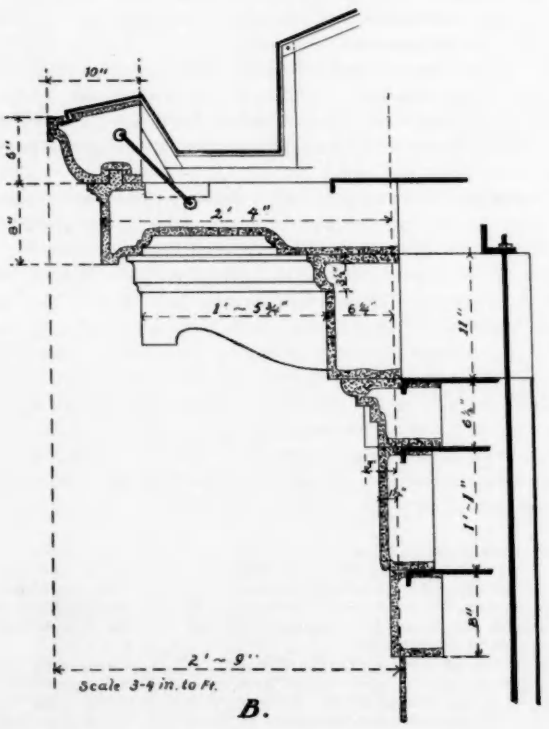
By permission of the Clay-Worker.

REFERRING to the far-projecting Renaissance cornice, Mr. Twose introduces the question of economy. It is true such cornices cannot be produced economically in terra-cotta, but it is also a fact that even where true construction without the aid of hidden supports be employed a terra-cotta cornice is still a very great deal cheaper than a similar stone cornice. By better kilns, increased experience, and improved methods, and by fierce competition during a period of business depression, the cost of terra-cotta has been reduced nearly 50 per cent. within the last twelve years. There are now to my knowledge nineteen factories in the United States, having an aggregate capacity of approximately 100,000 tons. Their total production in 1894 was about one third of that amount. But even in more prosperous times, when these establishments would be fairly busy, and when terra-cotta could be sold at a profit instead of at cost or at a loss, even then the price of an elaborate classic or Renaissance terra-cotta cornice would be far below that of stone.

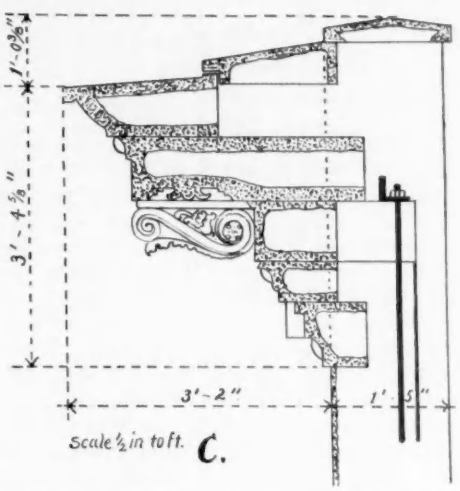
In practise it is entirely immaterial whether a cornice is the result of legitimate construction or whether some hidden supports are used to hold it. The æsthetical requirements are fulfilled as long as we know that such a cornice can be constructed from a given material, and as long as there is nothing to indicate an attempt at deception. As a matter of fact, terra-cotta is very well adapted for the modillion cornice, but in most of our buildings economy is the principal factor, and nothing but galvanized iron or copper will go. Our illustration "A" shows a terra-cotta cornice for a building now being erected. It has a projection of 3 ft. 2 ins., and needs no artificial support whatever. The angle iron and vertical anchor rods may be dispensed with; they are inserted for the convenience of the builder. The weight of the parapet wall is fully sufficient to balance the projecting portions by holding down the inner end of the bracket, but even without brackets the soffit piece alone would be sufficient to support the corona and coping. The bracket is about 9 ins. high and 8 ins. wide, by 18 ins. projection. It would require over 2,000 lbs. to break it. The soffit piece is also 9 ins. high, and would break under about 3,000 lbs. per running foot equally distributed. The coping behind the corona is inserted for economical reasons, as the former could easily be made the entire depth. Cornices with 4 or 5 ft. projection could be made of similar construction, but are usually secured to iron framework, not as much for sake of



economy, but for the reason that our buildings have no walls thick and heavy enough to counterbalance them. Section "B" shows similar construction, but in this case the parapet is replaced by the wall plate and by the weight of the roof resting thereon. This, again, is perfectly legitimate construction. Section "C" is identical with "A," excepting the omission of the parapet. Under these conditions we cannot dispense with the iron anchors, and our construction may be called illegitimate, but we should certainly fare a great deal worse if we had to deal with a similar stone cornice of more than double the weight. In theory this may be sham architecture, but in practise everything goes that looks well. Theoretically, the cornices of nearly all our buildings should not have more than 8 or 12 ins. projection, as the walls are seldom more than 12 ins. thick above the roof; but shall we, just to comply with some imaginary law, dispense with the beautiful effects of the far-projecting eaves? Many art critics smile disdainfully at skeleton construction as an architectural aberration — as something utterly base, and false, and unworthy of serious consideration from an æsthetical point of view. Is it not strange that these gentlemen forget that the most perfect and most beautiful of all art creations, the human body, is nothing more or less than the ideal solution of skeleton construction, the functions of the rigid frame of properly connected bones closely resembling those of the iron columns, beams, and braces, fat and muscles corresponding with brick backing and fire-proofing, while the skin and the terra-cotta facing respectively form the external finish of the structure? There is an almost perfect analogy. While admiring the beauties of man, do you think a great deal of internal arrangements and construction, of blood vessels, and intestines, and the awful skeleton which gives



rigidity to the whole? Do you care what that skeleton is made of, or do you think of explaining why the teeth don't drop out and why the knees don't collapse? Now, while the lines of vertical support are clearly shown by the piers, the horizontal floor divisions by the spandrels, and while the bright window-eyes give us a glimpse of interior arrangement of the building, is this not as much as the human body reveals to our eye of its own real construction? Of course, it is essential that a certain amount of flesh and fat be wrapped around the bones of the structure, thus not to become analogous to the living skeleton, for the limit of economy always excludes the beautiful. As long as there is sufficient mass of wall to impress the beholder with an air of stability, our building conforms with the æsthetical requirements; we need not lay it on the dissecting table to find how the muscle is attached to the bone, nor need we stick a bone through the skin to show that there is something inside to hold it up. We don't care. We know it stands now, and feel it must stand; that will do. What should all these anatomical phan-



tasies tend to show? In former papers I tried to prove that terra-cotta may be used constructively very much like stone; by aid of the illustrations published with this number I have clearly demonstrated the fact that it can be used constructively for classic cornices, although it need not necessarily be so used for the purpose. But my principal aim was to show that in skeleton construction the constructive properties of the material may be disregarded altogether, and that a plastic treatment of the entire exterior, where by skilful adjustment of joints and ornaments the former become invisible, and where the same impression is created as though a uniform coat of plastic material enwrapped the entire building, is æsthetically correct — probably more so than the customary surface construction in the mere skin of the wall.

EGYPTIAN BRICKS.

EGYPTIAN bricks were generally crude,— mixed with straw and dried in the sun; kiln-burnt bricks were occasionally used in foundations, quays, the raised terraces on which the towns were built, or in any situation where they would be exposed to frequent contact with water. The crude bricks were about 15 ins. in length, 7 ins. in breadth, and a little more than 5 ins. in thickness. This simple material was found to be peculiarly suitable to that dry, hot climate, where rain scarcely ever falls, and were further recommended by the ease and rapidity with which they could be made. The brickfields afforded abundant occupation for numerous laborers, and the demand was so great and the trade so profitable that the Egyptian Government took it into their own hands and considerably increased the revenue by this monopoly. In order to prevent unauthorized persons from engaging in this manufacture, a seal containing the name of the king, or some other privileged person, was stamped upon the bricks before they were dried; numerous bricks thus stamped have been found at Thebes and elsewhere. According to Vitruvius, crude bricks should only be manufactured in spring or autumn, in order that they may dry slowly; those which are made in the heat of summer speedily dry outside, while the inside remains moist; the brick thus becomes defective and easily gives way. He further observes that bricks ought to have been dried five years before they can be considered fit for use, and that their having been so should be certified by a magistrate. If these rules originated with the ancient Egyptians, it is probable that the stamp before mentioned may also have been a warrant of the solidity of the bricks.

Fire-proofing Department.

Conducted in the Interest of Building Construction to Prevent Loss by Fire.

FIRE-PROOF FLOOR ARCHES.

(*Continued.*)

BY GEORGE HILL, C. E.

PUBLISHED TESTS. — CONTINUED.

AUSTRIAN SOCIETY TESTS.[1]

INTRODUCTORY: — These were breaking tests, made of such arches as are commonly used in floor constructions and of small spans.

The test arches were erected in a courtyard of the Imperial Military Committee's Building, at Vienna, in the summer months of 1891, 1892, and one at Brün, in 1893.

Of the arches, seven had a span of 4 ft. 5.16 ins., seven of 8 ft. 10.2 ins., both sets having been sprung between iron beams. The remaining three had a span of 13 ft. 3.6 ins., with abutments of heavy masonry.

Four arches were constructed of ordinary bricks, five of flat tiles, three of concrete, three according to the Monier system, two of corrugated iron, and one arch constructed according to the system Melan.

Beside the testing of ordinary brick arches built in the usual two ways,— namely, with straight or diagonal courses,— the investigation of the several patent flat arches now manufactured in Austria seemed desirable, as these arches, giving flat ceilings, are of great value in practical construction.

It was further decided to draw comparisons between concrete and Monier arches on one hand and corrugated iron on the other, as the latter is often used in floors which are apt to be very heavily loaded.

In discussing the manner of building the test arches, and in fixing upon the spacing of the skew-backs, it was maintained that in spacing floor beams the fenestration or spacing of windows of a building was decisive; the distance between window centers reduced to an average was assumed at 8 ft. 10.2 ins.

It was therefore decided to build a series of arches having this span, and a second series having a span equal to one half this window axis spacing, or 4 ft. 5.16 ins.; this second series comprised all flat arches, their span being rarely over 4 ft. 11 ins.

All test-arches comprised in these two series were, for the sake of uniformity, constructed according to the practise usually followed in buildings; that is, they were to have I beams as abutments.

It would evidently have been proper to build the arches in rows, each row to contain at least three arches of one class, testing the middle span. This manner of building would, however, have occasioned too great an expense, even if sufficient space had been available. The same purpose would have been served by building all of the arches closely together; that is, two arches abutting against one I beam. If the work had been carried out in this manner, however, it seems more than probable that a failure or even a decided deflection of an arch would have seriously affected the adjoining spans.

To avoid all these mishaps, each arch was sprung between two I beams of its own, which were prevented from twisting or giving way in any manner whatever by suitable connecting members.

The arches were 6 ft. 6.7 ins. long throughout, the skew-backs being 8 ft. 6.3 ins., and held in place by three round tension bars.

To be able to watch the arches while they were under load, the beam ends were raised three feet above the ground, being placed upon separate piers composed of bricks laid up in Portland cement. Each pier was capped by an iron template and proportioned to the safe carrying capacity of the soil, to prevent all danger of settling.

In selecting the skew-backs and tension rods, an ultimate breaking load of from 819.2 to 1,024 lbs. per square foot was assumed; this load combined with the dead weight of the construction gave a fiber strain for the I beams and tie-rods of from 14,200 to 17,100 lbs. per square inch. Accordingly, for the arches of 4 ft. 5.16 ins. span, I beam, No. 28a and a rod of $\frac{1}{16}\frac{3}{8}$ in. diameter were used; while the arches of 8 ft. 10.2 ins. span received I beam No. 35, and rods of 1 $\frac{3}{8}$ ins. diameter.

The tie-rods had screw ends, nuts, and washers on both sides.

These tie-rods were quite sufficient to keep the skew-backs in place during the building of the arches, but they were evidently incapable of taking any additional strain, such as would result from a loading of the arches. It was, therefore, necessary to tie the ends of the skew-backs together in a manner which would, as nearly as possible, approximate to their being embedded in solid masonry, and reduce all possibility of a change in position on their part to a minimum.

The scheme to be adopted had to be, however, of such a nature as to admit of the watching and recording of any change in form or deflection of the arch which might take place during the test.

For this purpose the connections shown on Fig. 17 were adopted. They were composed of channel bars of sufficient cross-section, which were placed upon the ends of the skew-backs; to each end of a channel bar a pair of angles was connected by means of the plate shown, the angles being placed vertically and in such a manner as to hold the web of the skew-back between their projecting legs. In each leg of these angles two holes were tapped, so that it was possible, by inserting four tap screws or bolts at each connection and setting them up until they gripped the web of the skew-back firmly, to counteract any torsion or buckling of the latter.

[1] Report of Committee on Arches and Vaults of the Austrian Society of Engineers and Architects. (Translated from No. 20 of the Journal by O. F. Semsch.)

The Austrian Society of Engineers and Architects has always considered it as one of its most important objects to assist in the advancement of engineering and architecture in all of their branches; this endeavor has led it, among other things, to start and carry on exhaustive tests of the different kinds of arch constructions. These tests may be said to have been the result of a motion made in the weekly meeting held on March 23, 1889, by Engineer Victor Brausewetter, who proposed that exhaustive tests be made on the one hand with arches composed of rammed beton, and, on the other, with such built on the system "Monier," to investigate the respective characteristic qualities of the two systems. These tests were to be made under identical conditions for both systems.

The Committee on Cements, to whom this resolution was referred by the Executive Committee, arrived, after mature deliberation, at the conclusion that it would be desirable not to investigate the rammed beton and Monier systems alone, but that the Austrian Society of Engineers and Architects should in this case, as in so many previous ones, take the initiative and institute a series of rationally conducted tests on *all* the customary arch constructions, thus to determine, once for all, the safe carrying capacity of all of these different systems, and, as a secondary consideration, the various qualities, valuable and otherwise, of the materials which enter into their composition.

It was hoped that this would aid in the advancement of the "theory of the arch" in a way which could not be too highly appreciated.

This report of the Commitee on Cements was adopted, and on March 22, 1890, a committee composed of twenty-one members was appointed, in the first place, to arrange an exhaustive program, and then to complete all preliminary work necessary to institute the tests.

Before this committee, known as the "Committee on Arches," went into session, its chairman, Engineer Gaertner, had submitted to its members a paper prepared by himself, in which he had attempted the classification and description of all tests on arches which had been made up to that day; for this purpose, he had investigated the entire technical literature available on that subject. This paper was of great value and assistance in getting up the program for the proposed tests.

Although the active assistance of the commercial concerns interested in the manufacture of arches was surely to be counted upon, it was still evident that the manufacture of the necessary testing appliances and the development of the schemes for loading would necessitate expenditures which would certainly go far beyond the means which the society had at its disposal. Therefore, a request was sent to all government departments, especially the railroad department, also all companies and private concerns,— in fact, all those who are interested in the advancement of science and in the increased prestige of architecture and engineering, — to assist the endeavors of the society by contributing funds, work, or materials.

The extraordinary interest which the proposed tests awakened everywhere, and which found its expression in willing assistance from all sides, made it possible to conduct these tests on a scale never before attempted.

With regard to contributions in money, material, and labor, likewise cost of tests, Section VIII. of this report gives all necessary information; it will only be mentioned here that money was contributed to the sum of about $9,800, while the materials and labor contributed was equivalent to about $10,000. The committee on arches, therefore, considers it its duty to express its obligations for the hearty support with which it has met, and hopes that it has fully accomplished its object, — that of adding to the knowledge of the nature of arches, — by having made or conducted the tests described.

To go completely into the comparison between arches of concrete, those of the Monier system and of brickwork, it seemed also desirable to investigate arches with stationary abutments. These three arches could, moreover, be regarded as a connecting link between the floor arches (having small spans) and those of highway bridge arches. They therefore received a span of 13 ft. 3.6 ins. To prevent any lateral movement of the abutments, these were erected with an inward slope of the joints of 1 to 2.5. They were built of brick, with Portland cement, and their stability increased by placing small piers of medium height on top of them. (See Fig. 18.)

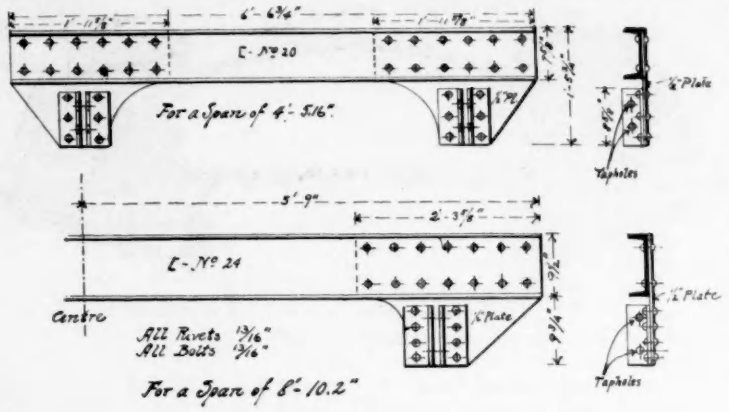


FIG 17-SHOWING MANNER OF CONNECTING ABUTMENT BEAMS

TESTS. For loading purposes iron and steel blooms were available. To get as uniform a load as possible, a layer of cinders, etc., was evenly distributed over the arch to be tested, and a planking composed of floor boards was placed thereon. The testing of an arch took place after it had had at least four months to set.

Short Spans. The arches of 4 ft. 5.16 ins. span could, on account of their small breadth, be loaded over their whole surface only; while the two other classes, those of 8 ft. 10.2 ins. and 13 ft. 3.6 ins. span,— the former sprung between I beams, the latter between masonry abutments,— could be loaded eccentrically.

It should be noted that all arches, though varying in thickness, were constructed for a safe carrying capacity of 123 lbs. per square foot, and, as has been stated above, were expected to fail under a load of from 819.24 lbs. to 1,024.0 lbs. per square foot, this corresponding to a factor of safety of about eight, which conforms very well with good practise.

But in the case of the arch loaded over its entire surface, — that having a span of 4 ft. 5.16 ins.— a load of 1,024 lbs. per square foot not only failed to cause a breaking down of the arch, but even left it intact, so far as dangerous cracks or fissures were concerned, so that the imposed load had to be increased.

The increasing height of the pile of iron blooms made it necessary, however, to take measures to protect the workingmen from injury, in case the arch suddenly failed.

For this purpose two pairs of strong uprights were placed on each side of the arch. These were braced laterally. Into the space between them long horizontal beams were placed, corresponding in height with that of the pile of blooms, which could thus fall against the screen so formed, in the event of the arch failing.

In the case of the first two classes of test arches, brick arches with headers or stretchers (Fig. 19), the loading was interrupted after 1,433.60 lbs. per square foot had been applied, because the arches had as yet undergone no dangerous deflection, and an increase of the load would undoubtedly have led, in the first place, to a deformation of the skew-backs and tie-beams.

In the case of all other arches of this span the load was increased to about 1,638.4 lbs. per square foot, which load actually caused two flat arches (systems Glückselig, Fig. 23, and Schneider, Fig. 22,) to fail entirely, while the two other types of flat arches, including the concrete arch, were still able to carry it with sufficient safety.

The amounts of deflection measured at the crown after each successive load had been applied, as well as all other observations, are given in Table A, the numbers in brackets giving the deflections after the loads had been removed.

To measure the deflection, iron rods of ⅜ in. thickness were

TABLE A. ARCHES OF 4 FT., 5.16 INS. SPAN.

Number of Load.	Load in pounds per square foot uniformly distributed.	Deflection of crown in inches.							REMARKS.						
		Flat arch, system;				Brick arches, with		65	Flat arches, system;				Brick arches, laid		
		59 Schober, Fig. 20.	60 Hönel, Fig. 21.	61 Schneider, Fig. 22.	62 Glückselig, Fig. 23.	63 Headers.	64 Stretchers.	Concrete arch.	Schober, see Fig. 20.	Hönel, see Fig. 21.	Schneider, see Fig. 22.	Glückselig, see Fig. 23.	Headers.	Stretchers.	Concrete arch.
1	102.40	.0197	.0079	0158	.0236	.0236	.0394	.0118	Thickness at crown 3/16 ins., rise 1 5/8 ins., weight 130.5 lbs. per square foot. Re 6) joints opened at crown; after load had been removed arch was still intact; no cracks in voussoirs apparent.	Thickness at crown 3/16 ins., rise 1 1/8 ins., weight 71.8 lbs. per square foot. Re 4) joint at crown opened, re 5) horizontal opening entire length of arch; after removal of load arch was still intact; no cracks visible on surface.	Thickness at crown 3/16 ins., rise 1 1/8 ins., weight 128 lbs. per square foot. Re 4) opening of joint near crown, re 8) horizontal crack in one voussoir, re 19) complete failure.	Thickness at crown 3/16 ins., rise 1 1/8 ins., weight 125 lbs. per square foot. Re 3) joint opened at crown, several voussoirs failed; re 5) fragment detached from crown; re 11) one skew-block failed; re 17) complete failure, after all crown voussoirs and skews had been crushed.	Thickness at crown 5/16 ins., rise 5/16 ins., weight 70.9 lbs. per square foot. Re 7) one voussoir crushed, re 11) opening of joint visible, re 13) a second voussoir crushed; after load was removed the arch still seemed intact.	Thickness at crown 5/16 ins., rise 4 7/8 ins., weight 77.1 lbs. per square foot. Re 4) middle joints opened, re 12) cracks visible on several voussoirs; after load was removed the arch seemed still intact.	Thickness at crown and skews 2 1/8 ins., rise 4 5/8 ins., weight 93 lbs. per square foot. Re 1) crack at crown, re 7) second crack all over arch; after load was removed arch seemed still intact, in spite of the great permanent deflection.
2	204.80	.0354	.0197	.0276	.0667	.0315	.0787	.0945							
3	307.20	.0552	.0708	.0591	.1340	.6300	.1379	.1498							
4	409.60	.0748	.0984	.0945	.1852	.0945	.2048	.2480							
5	512.00	.1024	.1419	.1379	.2520	.1340	.2678	.2810							
6	614.40	.1300	.1890	.1772	.3150	.1693	.3463	.2995							
7	716.80	.1576	.2322	.2242	.4095	.2168	.3940	.3543							
8	819.20	.1852	.2719	.2758	.4725	.2600	.4525	.4020							
9	921.60	.2163	.3112	.3270	.5590	.3072	.5195	.4490							
10	1,024.00	.2480	.3463	.3741	.6572	.3662	.5745	.4920							
11	1,126.40	.2758	.3820	.4490	.7640	.4140	.6300	.5350							
12	1,228.80	.3072	.4330	.5240	.9290	.4570	.7160	.5904							
13	1,331.20	.3423	4725	.6140	1.0510	.4960	.8342	.6375							
14	1,433.60	.3820	.5200	.7080	1.1930	.5475	.9522	.6772							
15	1,436.67	.3900	.5390	.7165	1.2020	.5515 [.2205]	.9560 [.6492]	.6810							
16	1,536.00	.4175	.5749	.8320	1.4380			.7160							
17	1,638.40	.4570	.6140	.9480	1.6490 Failed.			.7720 [.7600]							
18	1,646.18	.4650 [.1419]													
19	1,651.30			.9680 Failed.											
20	1,715.81		.6572 [.2758]												

attached to each arch at the crown. Stakes were driven into the ground and cast-iron triangles fastened to them in such a way as to have their two legs absolutely horizontal and vertical respectively; by means of suitable scales, the movements of the iron rod, with regard to the triangle, could thus be measured readily.

The movement of the crown in a horizontal sense, while the arch was fully loaded, could only have been incidental; as a matter of fact, these deflections varied constantly and were omitted entirely from the tables.

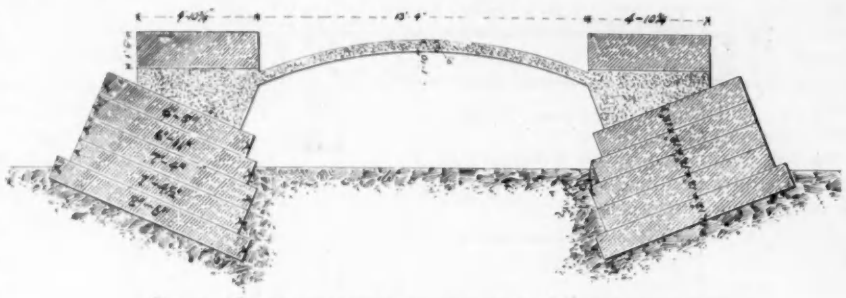


FIG. 18-CONCRETE ARCH WITH MASONRY ABUTMENT.

From a comparison of these seven arches with each other, all having a span of 4 ft. 5.16 ins., the following conclusions may be drawn: —

(*a*) The two brick arches laid up in white lime mortar, with a

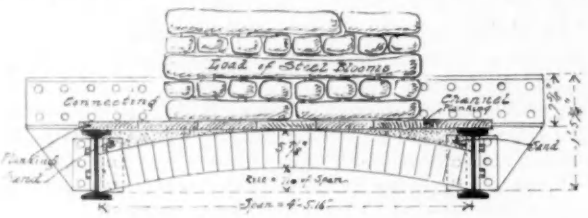


FIG. 19-SECTION OF BRICK ARCH

rise equal to $\frac{1}{10}$ of the span, have, under a load of 1,433.6 lbs. per square foot, shown so little change that the ultimate load can safely be assumed to be very much higher. It may, therefore, be said that such arches — good workmanship and material being guaranteed —

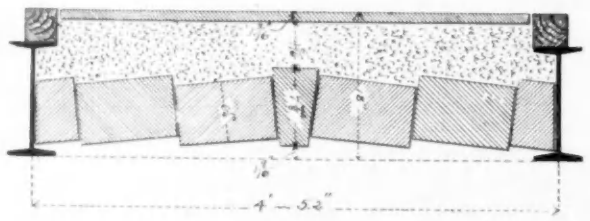


FIG. 20.

will be sufficiently safe for all practical purposes, even with an increased span. But this is only true for a uniformly distributed load.

Of the two ways of laying this arch, — headers or stretchers, — the latter has in every case shown a superiority, inasmuch as arches laid up in this way deflected less; which may be accounted for by the fact that there are a smaller number of joints, in a section normal to the skew-backs, in an arch of this kind.

(*b*) The deflection of the concrete arch $2\frac{13}{16}$ ins. thick, laid up of

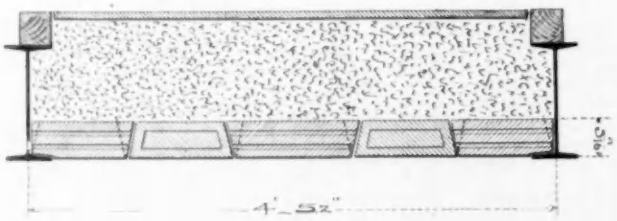


FIG. 21.

one part Kirchdorfer Portland cement and five parts sand, was about equal to the average of the deflections of the two brick arches just mentioned. This arch is, therefore, very well suited to replace a brick arch of a thickness of 5⅞ ins.

Besides the decrease of $2\frac{13}{16}$ ins. in thickness, these concrete arches have an advantage over the brick arches in their lesser weight; hence it is advisable to use this arch wherever good, cheap bricks are not available.

(*c*) The four flat arches have shown an unexpectedly high carrying capacity, and, therefore, afford — provided the skew-back beams are not placed too far apart, and the workmanship is first class, — complete safety for all practical building purposes. *But one must not be too economical in the use of tie-rods*, when adopting any of these systems, to prevent any lateral deflection of the floor beams.

These systems of floor arches show appreciable differences among themselves; two, for instance (systems Schober, Fig. 20, and Hönel, Fig. 21,), gave evidence of a very small deflection, even less than that of the brick arches; and a load of 1,638 lbs. per square foot caused them to undergo very little change, while the two other

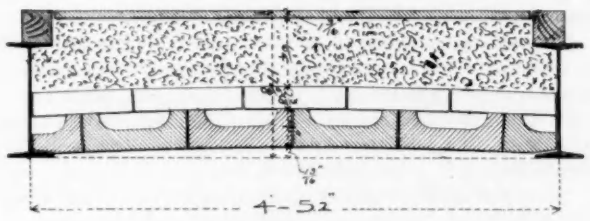


FIG. 22

systems, Glückselig (Fig. 22) and Schneider (Fig. 23) failed under this load, after having shown considerable deflection beforehand.

This may be explained by the fact that the voussoirs used in the two latter systems are of a very complicated form; they cannot, therefore, be made by hand, but dies must be used in their manufacture. This does not permit of the extensive use of sand; the voussoirs, as a consequence, are very brittle, so that they begin to show signs of breaking under a relatively small load (614.4 lbs. per square foot).

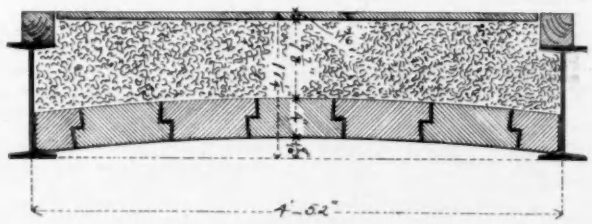


FIG. 23

The peculiar form of the key of these systems further results in an uneven distribution of the load, the stresses being unduly great in some places and very small in others. The concerns manufacturing such systems often maintain that these complicated voussoirs are a very good feature, their shape making it possible to lay the arch up dry; this, however, ought to be regarded as undesirable, for it might encourage careless workmanship.

(*To be continued.*)

Mortars and Concrete Department.

Devoted to Advanced Methods of using Cements and Limes in Building Construction.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER V. — *Continued.*

PROF. E. T. COX, in his report of the geological survey of Indiana, renders an interesting, and, in view of the question of antiquity, a valuable acquisition to our knowledge of ancient mortars and concretes; and the question arises, was the old or the new world the first to produce from materials which to-day would be considered as useless for such a purpose a mortar or concrete, which, being placed below ground, would become hard and stone-like in character and remain so throughout all the centuries that have elapsed since their first fabrication.

Prof. Cox says, "It is not alone in Europe that we find a well-founded claim of high antiquity for the art of making hard and durable stone by a mixture of clay, lime, sand, and fragments of stone; for I am satisfied that this art was possessed by a race of people who inhabited this continent at a period so remote that neither tradition nor history can furnish any account of them.

"They belonged to the Neolithic or polished stone age. They lived in towns and built mounds for sepulture and worship, and protected their homes by surrounding them with walls of earth and stone. In some of these mounds specimens of various kinds of pottery, in a perfect state of preservation, have from time to time been found, and fragments are so common that every student of archæology can have a bountiful supply.

"Some of these fragments indicate vessels of very great size. At the Saline Springs of Gallatin County, Ill., I picked up fragments that indicated, by their curvature, vessels five to six feet in diameter, and it is probable that they are fragments of artificial stone pans used to hold brine that was manufactured into salt by solar evaporation.

"Now, all the pottery belonging to the Mound-Builders' age which I have seen is composed of alluvial clay and sand or a mixture of the former with pulverized fresh water shells.

"A paste of such a mixture possesses in a high degree the properties of hydraulic pozzuolana and Portland cement, so that vessels formed of it hardened without being burnt, as is customary with modern pottery. The fragments of shells served the purpose of gravel or fragments of stone as at present used in connection with hydraulic lime in the manufacture of artificial stone.

"It will be seen by the following analysis of a piece of ancient pottery from the 'Bone Bank,' in Posey County, Indiana, that, so far as chemical constituents are concerned, it agrees very well with the composition of hydraulic stones.

"ANCIENT POTTERY, 'BONE BANK,' POSEY COUNTY, IND.

Moisture at 212° F.	1.00
Silica	36.00
Carbonate of lime	25.50
Carbonate of magnesia	3.20
Alumina	5.00
Peroxide of iron	5.50
Sulphuric acid	0.20
Organic matter, alkalies, and loss	23.60
Total	100.00

"It is my opinion, based upon the result of its analysis, that it is simply an artificial stone made from a mixture of river mud and pulverized fresh water shells. Instead of softening in water, as they would if made of clay alone, the shells give to the composition hydraulic properties, and vessels made of it harden on exposure to air and moisture. When filled with water and meat, pots made of this material could be placed over the fire and heated without fear of breaking them.

"Those ancient artisans must have been aware of the advantage derived from a thin body to resist breakage from expansion and contraction from the heat of the fire.

"I have a beautiful vessel from the 'Bone Bank,' made of artificial stone, which has ears, and is otherwise formed like an old-fashioned cast-iron dinner pot. It is five inches across the mouth, and seven inches in diameter at the bulge, five inches deep, and only one eighth of an inch thick. The bottom is smoked black, which goes to show that it was suspended over the fire for cooking purposes."

It will be noted that Prof. Cox describes the lime and magnesia as carbonates, and states that they are in the form of pulverized shells, and so used in the mixture, while Dr. Wallace takes the position that the lime was calcined and subsequently became carbonated.

By giving the carbonic acid its full equivalents of lime and magnesia to form carbonates of those bases, and the sulphuric acid its full equivalent of lime to form sulphate of lime, in the mortar from the temple at Pentelicus, as given by Dr. Wallace, it will be found that the excess of lime is so slight as to preclude the belief that the lime was calcined prior to its use, and that the position taken by Prof. Cox is the correct one, and it is not difficult to believe that in all these ancient mortars named, pulverized carbonate of lime was the cementing agent used.

The "Old Stone Mill" at Newport, Rhode Island, which, according to many learned antiquaries, was built by the Norsemen five hundred years before the landing of Columbus, was constructed with a mortar composed of pulverized shells, clay, sharp sand, and fine gravel.

The antiquity of this ancient structure has been a subject of much discussion.

J. P. MacLean, in *American Antiquarian*, stoutly maintains that it was built by or upon the lands of Gov. Benedict Arnold during the period of his residence at Newport, which was from 1653 until his death in 1678.

Mr. MacLean states that in the year 1848 some mortar taken from an old stone house in Spring Street, built by Henry Bull in 1639 (the year in which Newport was founded), some from the tomb of Governor Arnold, and some from various other buildings was compared with the mortar of the Old Mill, and found to be identical in quality and character.

Whether the Old Mill has been built more than nine hundred or only a little over two hundred years, the fact remains that the mortar with which it was constructed is composed of the materials as stated, and a careful examination of this structure, by the writer, during the summer of 1894, revealed some curious features which are not easily adjusted to modern ideas of stability.

The stones are mostly small and unshapen, and in many places the mortar joints are over an inch in thickness. Taken altogether, the work was carelessly done, and how such a wall could have been held in place for even two hundred years with such a mortar, and in such a climate, seems almost incredible. There are no indications of crumbling on the part of this curious mortar; on the contrary, it is hard and firm, and from present appearances is liable to remain so for centuries to come. The fact will not be overlooked that this mortar is composed of identically the same materials as are those mentioned by Prof. Cox as having been used by the Mound-Builders, which fact is rather damaging to the theory adduced by Mr. MacLean in his attempt to overthrow the arguments advanced favoring the antiquity of the "Old Stone Mill."

It would be a rash man who, to-day, would build a structure of any importance with a mortar composed of pulverized shell, marl, clay, and sand; and yet, with the evidence before us of its having been so used in the "Old Stone Mill" in New England, where it has

been subjected to alternate freezing and thawing through all these years, and even accepting Mr. MacLean's theory as to the time which has elapsed since its construction, it antedates by a full hundred years the time when Smeaton "lightened up the darkness surrounding the subject of mortars and their behavior under varied circumstances," it would seem that the permanence and durability of shell-lime, *i.e.*, carbonate of lime, mortar must be conceded.

But it is not at all clear how a mortar composed of such materials can, without calcination, become hard. It is quite true, as stated by Prof. Cox in his reference to the analysis of ancient pottery, that "so far as chemical constituents are concerned, it agrees very well with the composition of hydraulic stones;" yet this does not by any means constitute an hydraulic cement, which, it may be inferred, was meant by him where he states that "a paste made from such a mixture possesses in a high degree the properties of hydraulic pozzuolana and Portland cement, so that vessels formed of it hardened without being burnt, as is customary with modern pottery."

It is true that Portland cement is made by an admixture of clay and carbonate of lime; yet, however thoroughly and intimately these two ingredients may be commingled, it is clear to every one who is at all familiar with the subject that this mixture, without further treatment beyond its mere mechanical incorporation, cannot be induced to harden beyond a natural moderate hardness due to the drying out of the clay.

By submersion it soon becomes plastic again. At such a stage, and in such a condition, there is no chemical affinity between these substances.

There are present two acids and two bases. Each of the former is chemically combined with one of the latter, in certain fixed proportions.

The lime is combined with 78.57 per cent. of its own weight of carbonic acid, which in hundred parts is lime 56, carbonic acid 44 = 100 carbonate of lime.

But clay is rarely found in true combining proportions, the silicic acid almost universally predominating. The latter combines with nearly 57 per cent. of its own weight of alumina.

The ratio in one hundred parts being silicic acid 63.83 and alumina 36.17 = 100 silicate of alumina.

In the analysis given by Prof. Cox, the silica is 36.00 and the alumina is 5.00. Therefore, as the 5.00 of alumina will combine with only 8.82 of the silica, forming clay 13.82, there must necessarily remain 27.18 of free and uncombined silicic acid, and this cannot combine with the lime, which already has its full equivalent of acid; and although the latter is volatile, it will not part from its combination with the lime, except through the agency of heat, even though the carbonate of lime is in intimate contact with free silicic acid through countless centuries, as is shown in the natural cement rocks throughout the world, nearly, if not all of which contain more silica than will combine with the alumina present, and which in no manner affects the relative proportions of the constituent parts of the carbonate of lime. (*To be continued.*)

VARIOUS SYSTEMS OF CONCRETE CONSTRUCTION.

CONTINUED FROM APRIL NUMBER.

CONCRETE AND TWISTED STEEL.

RANSOME SYSTEM.

THE essential idea concerning the use of twisted steel and concrete is that the resulting construction is a beam and not an arch. This at once gives it a field of its own, and sets it apart from all other systems involving the use of steel, for invariably, in all other practical results, the arch is the basis of the structure. In the Melan system, the principle used is the arch, although the economy with which iron is used in the construction renders the system exceedingly valuable from a practical standpoint. This system is essentially adapted to bridge construction, while the Ransome system is of greater value in floors, girders, and flat structures.

The manner of calculating the proportions of a concrete beam has already been described.

The sectional area of the tension bar is determined in the same manner as the flange of an I beam. The sectional area of the concrete in the upper third must be at least fifty times the area of the tension rod.

The concrete should be composed of good materials, that is, of a cement of requisite strength and fineness, and of small aggregates consisting of any of the following, which are named in order of merit: hard limestone rock, hard burned brick or broken pottery, granite or basalt, hard clinker, broken flint or other hard rock, gravel. Care should be taken to use only clean materials, free from dust or impurity of any kind. The aggregates should be broken to pass through a 1 in. mesh, and all fine dust removed. The mixing should be thoroughly done, and sufficient water added to bring into the condition of stiff, tenacious mortar.

"It is of vital importance for the strength of the structure that the iron bars be placed no higher in the beam than calculated for; that the longitudinal center of these bars should be at the lowest point, and it is advisable that the bars curve upward slightly and uniformly each way from the center to the ends, so that the ends are from 1 to 2 ins. higher than the center. No crooked or irregularly twisted bar should be used; otherwise there is danger of straightening and consequent fracture in the beam." A bed of concrete is first laid and the bar placed in the requisite position; then the balance of the concrete is put in place, so as to form one solid homogeneous mass.

The most economical spacing for beams is about 27 in. centers. Where the beams are farther apart, as they readily may be, even as much as 15 or 20 ft., small rods should be run at right angles to the beam.

The sizes of beams for different bars are given below:—

For ½ in. bars, the beams should be 1½ in. thickness and 25½ in. on centers.
" ¾ " " " " " " 2¼ " " " 26½ " " "
" 1 " " " " " " 3 " " " 27 " " "
" 1¼ " " " " " " 3¾ " " " 27¾ " " "
" 1½ " " " " " " 4½ " " " 28½ " " "

Bars larger than 1½ ins. are rarely used.

For spans up to 25 ft. the following are the proper dimensions of beams. "Thickness" refers to the size of the upper third, or compression area, and "Depth" to the distance from the top of the beam to the center of the bar.

SPAN 10 FT.

Safe load in pounds per square foot.	Approximate weight of floor in pounds per square foot.	Size of Twisted bar in inches square.	Thickness of upper third of concrete in inches.	Depth in inches from top of beams to center of bar.
50	17	½	1	6.
125	24	¾	1¼	6.
250	35	1	2	6.75
500	44	1	2	12.75
SPAN 15 FT.				
50	24	½	1¼	6.
125	26	¾	1¼	7.75
250	44	1	2	12.75
500	62	1¼	3	16.25
SPAN 20 FT.				
50	29	¾	1¼	10.75
125	45	1	2	13.25
250	62	1¼	3	16.
500	97	1¾	5¼	16.25
SPAN 25 FT.				
50	41	1	2	10.75
125	60	1¼	3	15.
250	83	1½	4	19.
500	126	2	6¼	20.75

The floors in the Pacific Borax Company's warehouse in Alameda, Cal., are of 20 ft. span, built for 200 lbs. safe load, and of section approximately as above; and they have been loaded repeatedly with excessive weights, sometimes as high as 550 lbs. per square foot with a deflection of only $\frac{1}{16}$ of an inch.

The floors in the Academy of Sciences in San Francisco were loaded when only a month old with 480 lbs. per square foot; span, 22 ft.; bay, 15 ft.; deflection, $\frac{1}{8}$ in.

A specimen beam, 17 ft. long, recently sustained a load of 1,060 lbs. per foot with a deflection of $\frac{1}{16}$ of an inch. Final fracture after three days was due not to the load, but to the undermining by rains of the pier on which one end of the beam rested.

Many other tests of the actual working value of the construction are on record, and, to the writer's knowledge, there has never been an instance of failure of any kind, although the tests have been extreme ones.

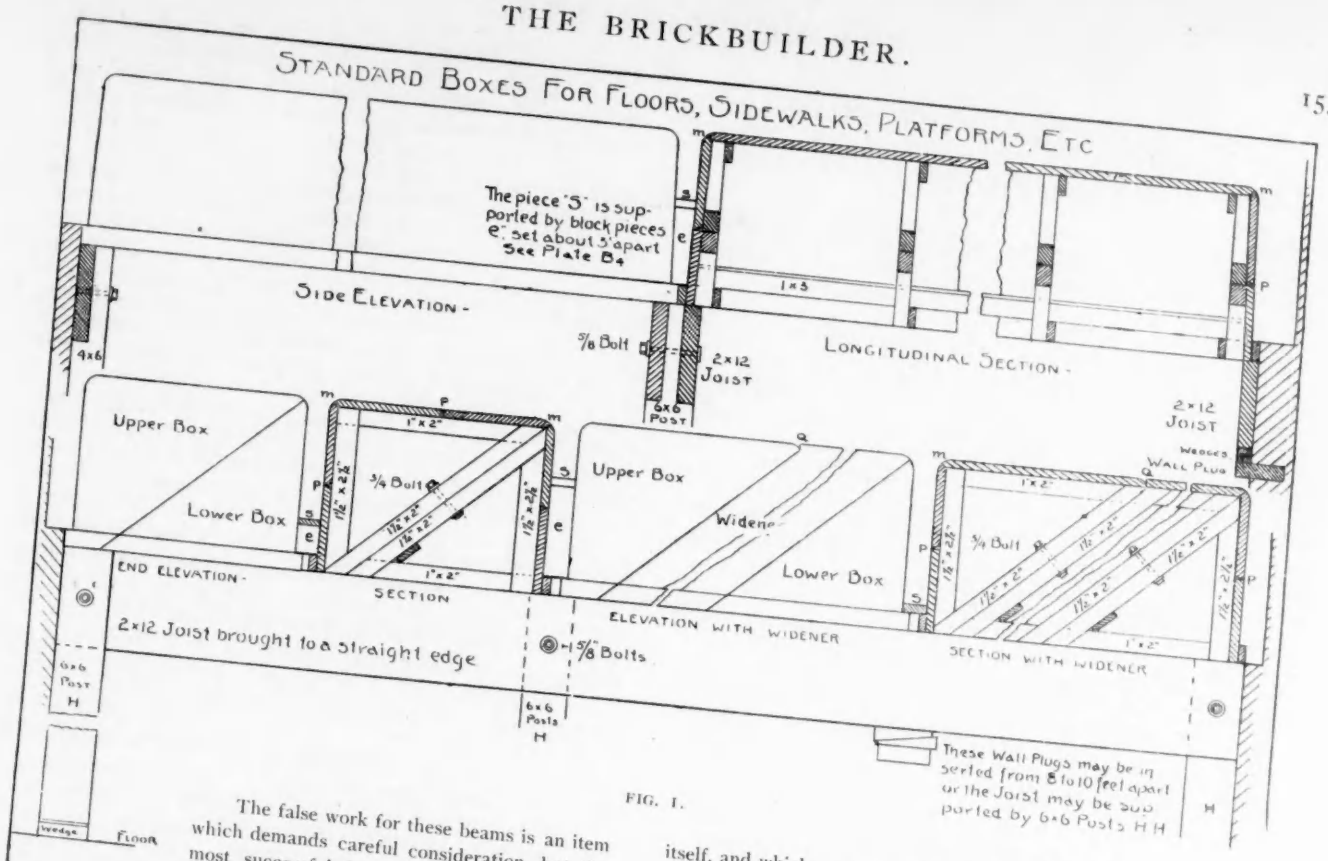


FIG. 1.

The false work for these beams is an item which demands careful consideration, but the most successful form of center is that shown in Fig. 1. It consists of a box cut through on a diagonal in such a manner that the two parts may be locked together and set in place, and after the concrete is properly hardened, the lower half of the box is detached, and then the upper half is readily taken out. This center may be used continuously and the expense of centering thereby greatly reduced.

The chief difficulty encountered in constructing centers for concrete, especially in caissons, panels, etc., is in the swelling and binding of the wood, requiring everything to be cut on a bevel and necessitating much waste in stock and labor. This is largely overcome in the device spoken of.

In a number of ways flat ceilings may be made, and then the floor is hollow and has all the advantages accruing from that feature. A key may be made on the lower edge of the beam and a slab of concrete, staff, or other material set upon these keys and plastered. Mr. Ransome recommends making these slabs in place of plaster or cement, but sometimes this is not feasible on account of the lack of depth in the beam, notably in small spans. The most satisfactory method, at least for small spans, seems to be in embedding wire in the concrete about 3 ins. on centers, passing in a loop over the bar, leaving the ends protruding. Wire lath, expanded metal, or other similar material may then be readily fastened to these wires and the plaster coat put in place.

For dwelling-houses, office buildings, hospitals, asylums, and that class of buildings, a very pretty paneled effect may be produced by using the beams and the flat floor filling, a panel 16 ft. by 20 ft. being easily constructed. By using the ordinary beam spacing and the flat ceiling, the results attained in the ordinary fire-proof floor are reproduced in a very superior fashion. For the wearing surface, mosaic, tile, wood flooring of various kinds are most popular in light floors, and the great rigidity of the concrete beam gives the floor many advantages over the steel beam in the matter of deflections. For breweries, malt houses, packing houses, and similar structures there is no better floor in existence, for the concrete may be finished with a hard wearing granolithic face which is a part of the floor itself, and which may be flooded with water constantly, or covered with any kind of wet material without danger of rotting the floor or even of retaining any germs or particles of the material. The floor is practically indestructible by fire or water, will withstand the heaviest traffic and wear, is exceedingly strong, besides being inexpensive and readily adaptable to any building, and easy and quickly constructed.

In a subsequent paper some methods of attaching a wood top to a concrete floor will be described.

ROSS F. TUCKER.

CHICAGO, ILL., July 1, 1895.

PUBLISHERS OF THE BRICKBUILDER:

Gentlemen, — Several weeks ago I explained to your representative the difficulty of securing durable outside plaster or cement "rough cast" either in plain surfaces or with half timber work. He suggested that I write you and endeavor to call out a full discussion of outside plaster work which is in line with your most valuable papers on cements and mortars. There seems to be many different opinions as to the best method to follow for combined durability and effect; some, including one of our most eminent practical architects, advocating pure lime mortar with long hair or fibre, and others claiming that only pure cement mortar on metal lath or "expanded metal" can be relied upon. On a half-timbered country house built a year ago, I used lime sand and hair mortar on metal lath for the first coat, and cement and sand (one to one) for the second coat after the first had hardened for some time; the mortar and hair taking a strong "clinch" in the metal lath, and the cement forming a thin, extremely hard protecting "skin" over the first coat. I should say that the work would be much better if the first coat were left uncovered for four or five weeks at least, in order to harden under atmospheric action, but so far this piece of work seems successful. As a number of us younger men in Chicago have a strong liking for plaster externally in connection with brick and timber, I am sure that many of your readers would be very much pleased to find in your columns a discussion by those who are especially informed in this rather unusual direction. Hoping, personally, that others will give both theories and practical experiences, both as to English and American practise, I remain,

Yours sincerely,

R. C. S., JR.

The Mason Contractors' Department.

Conducted in the Interests of the Builder and the Contractor for Brickwork.

CONSTRUCTION OF HIGH BUILDINGS.

AS the land in the center of large cities becomes very much advanced in price and becomes exceedingly valuable, and the space to be roofed in is absolutely limited by our neighbors' land and the lines of streets, while there is a demand for yet more space than can be obtained by the ordinary methods and plans, the only thing to do is *to go higher*. This custom is observed by almost every intelligent traveler; as he passes through a given city he finds all the buildings six or eight stories high in the center of the city, and as he passes along the suburbs sees nothing but two or three story structures, for on the outskirts land is cheap and plenty, and is a temptation for a man to spread out and fence in all he can get hold of for his individual use and enjoyment; but the owner of the lot in the center considers himself rich if he owns but one lot, and sets himself about its improvement by pulling down the small building and building greater, higher, if possible, than his neighbors were willing to go.

Indeed, it seems at times as if the same spirit which actuated the building of the Tower of Babel is again abroad in the land; and yet, high as they built, there is no record of the walls or any part of the foundations giving away under them. They had no architect; if they had, his name has not been handed down to us. It appears, as far as we can learn, that they lost the power of intelligent language among them, and just as soon as the age of high building comes in this country there comes also such a diversity of language on them that it is no rare thing for an interpreter to be constantly employed to give in language the men can understand directions how to build.

High building has also brought about a complete change in the manner of raising the material to the dizzy height at which it is to be built into the walls. Many men who read this paper can readily remember when the first steam engine was called into use for this purpose; indeed, it is not over a dozen years ago that the price of high party walls was reduced to the same as lower walls, simply because such high buildings can now be erected with these new facilities as cheaply as low buildings.

As these very high buildings in a given square increase, the objectionable character of the upper stories is in the same ratio decreased; for it is exceedingly offensive, while occupying, say, a sixth story room, the window of which opens out over a chimney top of a cobbler whose only means of keeping a little warmth in his room is by burning his leather parings, which sends up such a cloud of offensive smoke as to render such a room almost uninhabitable except with closed windows. So much is the tenant of such a high room annoyed that he gives notice to his landlord that unless this most intolerable nuisance is abated he will be compelled to vacate. So the landlord sets about getting his lowly neighbor to raise his chimney, when he finds out for the first time that he did his best to induce the bricklayer who built these high walls to raise his chimneys at the same time, but he refused unless he was paid beforehand for doing it; and on conversing with his bricklayer he also learns from him the difficulties of raising a neighbor's chimney; and the result is that every architect of sound judgment now carries up in his plans his neighbor's chimneys, in order to strengthen his building, and to save his future tenants this annoyance, and so increase the demand for the upper stories.

I believe it was De Quincy who was asked why he lived in the sixth story of the Scotch town where he dwelt, and his reply was, "Because I cannot get a seventh story." He had found it an excellent hiding-place from boring callers, and he got plenty of light.

The chief advantage, perhaps, and which at first prompted high building, apart from the question of increased room which it enabled one to roof in, was the advantage of a cheap ground rent for the square foot of habitation thus so largely increased.

Yet a certain English writer has labored hard to show that the largely increased price of high buildings necessitated by the exceedingly broad and deep foundations and of the extraordinary skill and care required, make these cost a much larger sum than otherwise, and also the extra thickness of the walls above. Indeed, he says, a certain London architect could not get large enough foundations, though he had covered the entire lot, the lot being 50 ft. front, and each foundation being 26 ft. wide. More land had to be bought on which to rest the foundations; therefore, this writer advises more buildings of less height, thus forgetting entirely the fact that there is no more land to be had at that spot; it is all taken and highly prized and the owner refuses to part with it except at a higher figure than it will cost him to go up, up, up, six, eight, ten, twelve, fourteen, aye, twenty stories!

I have referred briefly to the fact that high buildings had *come* and come to stay. This fact becomes more evident when we remember that the steam hydraulic elevator places all the stories on the first floor. No one has any doubt but that the number of these high buildings will be largely increased within the next few years.

It seems that, differ as we may as to every other point about high buildings, we all agree upon *one* point and it is this: That brick is the most desirable because the most fit material with which to construct the walls of high buildings for the following plain reasons, apparent to every practical mind:

First: Because so easily and cheaply obtained.

Second: Because brick is so very durable.

Third: Because so easily ornamented.

Fourth: Because it will not split and sprawl in case of fire, as will other material.

Fifth: Because so readily procured in almost any shape and color and in any quantities in almost every locality.

A close and critical examination of some of the large buildings in this country recently erected reveals an alarming degree of malconstruction, so that in some cases the strength is not only very much impaired, but the beauty considerably marred, if not entirely destroyed. I use the word "malconstruction" not unadvisedly, for it has been fully demonstrated, since a certain building in New York City was built, that *it is possible* to build walls no thicker, but very much higher and with wider span than that building has and make them perfectly secure. You must not simply veneer the outside face with a four-inch press brick driven down to a close, tight, hard joint, and then fill in behind eighteen inches thick with old bats and coarse mortar of half-inch joint; then at several intervals in a story tie this indifferent slouch work to the outer veneer, so that when four or five stories are reached the walls begin to settle down and the entire weight of the floors is thrown on the outside four-inch veneer, which was well calculated to carry 4,000 lbs. to the square inch, but not intended to carry 35,000 lbs. to the square inch, for its ultimate strength is not over 8,000 lbs. The result is readily seen. The press brick is crushed to powder and blown away by every passing breeze.

In striking contrast to this, we find such buildings as the Produce Exchange Building, New York, the walls standing straight and strong, no crushing or bulging. Everything about the walls shows the possibility of high grade mechanical ability.

Many other high buildings in all cities show equal strength. No sign of a crushed or even cracked brick or unequal settlement visible in any part of the building; these are all monuments to the memory of the builders; while the one crumbles and falls, the other stands firm and solid, and goes down the ages reflecting credit and praises to the builders.

Did the illustrious architect of St. Peter's at Rome have any doubt of the strength or stability of any of its parts? Did he not

make numerous and exhaustive experiments of every part of that immense pile before the workmen began?

Having modeled and tested every timber, wall, and beam, he was enabled to determine the strength and resistance of each to the other.

Suppose the illustrious sculptors who so successfully placed so much highly artistic ornamental work in every part of our Columbian World's Fair should have failed to measure, and mold, and magnify to their proper proportions and suitable strength every limb and ligament of those studied, stately statues. Suppose the shoulder of one to be so small as to be utterly unable to support the arm of disproportionate size and weight. Or, suppose the neck of another should be altogether too slender and long for the big head he had happened to hang thereon, would it be a sufficient answer if he should say: Wait till the next World's Fair you have; then I shall be better able to judge of these things? Then let us builders who are ever engaged in beautifying our cities and towns scorn to do a mean piece of work, to have the architect change it, but, rather, help on the fast-growing opinion that no man can become an efficient architect who is not a practical mechanic.

A BRICKBUILDER.

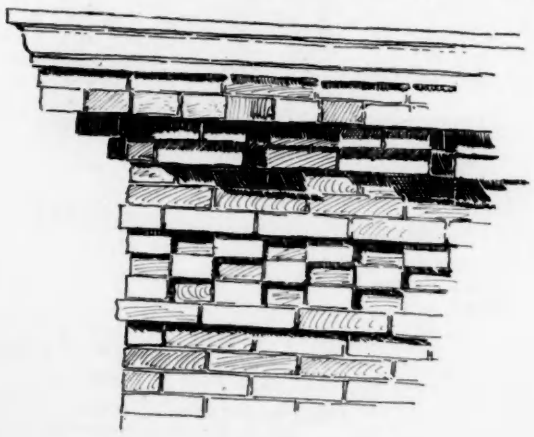
THE DETAIL OF CHEAP HOUSES.

THERE can be no definite rules given for the adornment of brick cottages, or, in fact, of anything else; for that which may be correctly applied in one case is generally entirely out of place in another.

There are, however, some points which, used with intelligence by the builder, may help him to relieve the blank monotony characteristic of so many of his houses.

The cheaper classes of brick dwellings in this part of the country seem to be divided into two classes, the absolutely plain and those overloaded with detail. Now, while there are some buildings which by reason of their proportions are beautiful, or, at least, not offensive to the eye, the majority could be much improved by a little simple detail.

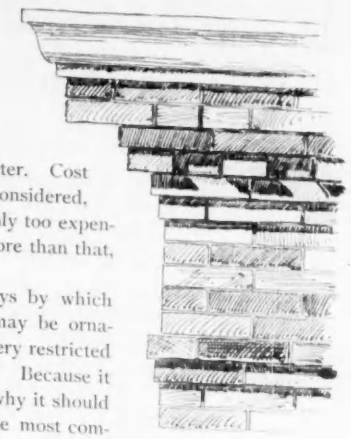
The builder, in the first case, puts up the cottage for the smallest



amount possible and gives himself no trouble as to its appearance; in the second, having an allowance for ornamentation, he selects from some book a cornice or a frieze, and, working out its construction, builds it in without thinking that, while it may be appropriate on an Italian villa, it is out of place and "bad" when looked upon as detail for a workingman's cottage.

It is the middle course which is necessary to good brickwork in cheap houses.

The idea of ornament, so far as we are concerned at present, at all events, is not so much to attract attention to this or that particular part, but to break up the surfaces, to soften the hard lines of the building, to strengthen in appearance parts seeming weak, and to tie the whole together into an agreeable mass.



The *simpler* the way by which this is done, the better. Cost is the principal thing to be considered, and elaborate detail is not only too expensive, but unnecessary; no, more than that, — objectionable.

There are plenty of ways by which an ordinary brick cottage may be ornamented at a cost within the very restricted limits of a "cheap dwelling." Because it must be cheap is no reason why it should be ugly; with nothing but the most common materials in the market, effects may be gained rivaling those of twenty times their cost.

LEGAL POINTERS.

A STOCKHOLDER of a corporation is entitled to have his attorney and stenographer accompany and aid him when he desires to examine its books.

LIABILITY OF INDEPENDENT CONTRACTOR. A person who has hired a contractor to do certain work and has no immediate control over the servants of the contractor is not liable to a person injured through the negligence of one of such servants.— *Supreme Court of Michigan.*

LIABILITY OF CONTRACTOR'S BOND. Where a building contractor abandons the work before it is completed and absconds, the guarantor of his contract, who elects to treat the failure and flight of his principal as settled facts and to cooperate with the owner in completing the work, becomes liable as surety.— *Supreme Court of Pennsylvania.*

RIGHT OF ADJOINING OWNER IN OVERHANGING WALL. The Supreme Court of New York, First Department, holds that where the owner of a lot erects a wall the foundation of which is wholly on his lot, but a part of which overhangs an adjoining lot, the adjoining owner will not be enjoined from removing so much of the wall as overhangs his property.

RIGHT TO MECHANIC'S LIEN FOR IMPROVEMENTS. Where a lease provides that the lessee may, at his own expense, alter and repair the building, one who makes the alterations under a contract with the lessee does the work "with the consent of the owner," within the statute providing who may acquire a mechanic's lien. Where improvements become part of a building, the fact that they were designed specially for the tenants' business will not affect the right of the person doing the work to a mechanic's lien.

CONSTRUCTION OF BUILDING STONE CONTRACT. A party offered to furnish another with building stone at $6.00 per cord, and the latter replied that he "would do better than that," and pay $6.50 per cord, measured in the wall. Both parties were experienced in the business, and knew that a cord of rough stone (128 ft.) makes only 99 cu. ft. of masonry. The Supreme Court of New York, Oswego County, held that it was the intention of the parties that the stone should be measured in the wall at the rate of 99 cu. ft. per cord.

MECHANIC'S LIEN — BOND OF OWNER. A bond given by the owner of buildings upon which a notice of lien for materials and labor has been filed, conditioned for the payment of any judgment that may be rendered against the property (as provided by the laws of New York, and some other States), takes the place of the property, and discharges and becomes the subject of the lien; and an action is maintainable upon the bond against all parties interested, including the sureties, without first foreclosing the lien upon the property. — *Court of Appeals, New Jersey.*

Recent Brick and Terra-Cotta Work in American Cities.

A Department Devoted to the Interests of the Manufacturer.

CHICAGO. — It seems like old times again in Chicago to look down into a great hole in the ground and see all the foundations in place for an office building, and the silent, deserted cast-iron stools waiting for the columns to rear their heads. Delay in furnishing steel after the dull period comes like a surprise. Manufacturers seem to have been flooded with orders all at once, so that now one finds his order, if accepted at all, on the file for some months ahead.

If it is true that the boom in steel is due to a demand for building purposes largely, it must be from smaller cities which have taken the office building mania; certainly Chicago is using, at present, comparatively but a small amount in large buildings. However, we must not forget that large all steel construction buildings use but a fraction of the amount of metal used in small buildings which have only a few girders or store front beams.

The foundations for the Atwood office building are in place, ready for the basement columns. The general contract is in the hands of the Geo. A. Fuller Company.

The ground is being excavated for the Winnebago eighteen-story office building, D. H. Burnham & Co., architects. The Guaranty Construction Company, 713 Medinah Temple, have the general contract.

Another large apartment building is projected. Its picture has been published in the daily papers, and the statement made that its nearly seven hundred rooms will be soon in course of construction. Jul de Horvath is the architect.

A matter of considerable interest to architects and physicians has occurred lately in connection with a new hospital for small-pox, planned by the city of Chicago. The buildings, twenty-five in number, were expected to cost about $200,000. Working drawings had been completed and the principal contract let for $125,000, by the administration which has lately gone out of power. Construction of the foundations was well advanced when discovery of defective work led to a suspension of operations. Then a desire by the new municipal administration to decrease the cost of the institution led to an investigation by a committee of physicians, headed by Dr. Hamilton of the United States Marine Hospital Service. They reported that the buildings as planned would accommodate only one hundred patients, and, being spread in a scattering fashion on ten acres of ground, would be exceedingly expensive in administration. They recommended as a substitute (also on the pavilion plan, but more compact in arrangement) a scheme in which the buildings of administration should form a central group, and be made of permanent fire-proof construction; and provision be made for building any number of separate wards, as necessity might demand; these to be of cheap construction for easy destruction.

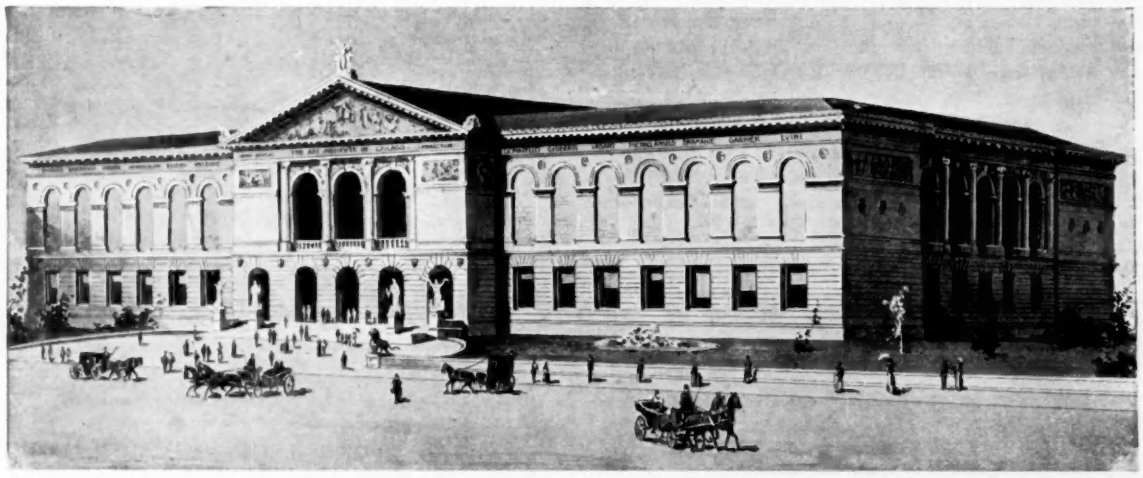
The Board of Health is making elaborate provision for vaccinating the population, expecting thereby to have less need in future than in the past for a large small-pox hospital.

There ought to be a great school of architecture in the central part of our country. For the cause of good architecture, we are glad to note that Chicago, with her two million inhabitants, has made a good beginning, and ambitious western students, when they find Boston Technology, or Columbia, or Cornell beyond them, are turning to the Art Institute; and if the progressive ideas of the chief patron of this institution, Mr. Chas. L. Hutchison, and the director, Mr. W. M. R. French, are any indication, the school of architecture in Chicago ought soon to equal the best.

The alliance between the Art Institute and the Armour Institute supplies, on the one side, the home and atmosphere of pure art, and, on the other, the necessary training in the technical arts.

The exhibition of students' work this year is a surprise, even to Chicago architects.

Aside from the plans and elevations of the usual fabulously expensive palaces and museums rendered in French academic style there are many well-done plates of "orders," shades, and shadows, perspectives, wash and water-color work, done after the system in vogue in Columbia. The neat sheets, showing graphic analysis and truss details, argue that construction is receiving due attention along with the artistic designing.



ART INSTITUTE BUILDING, CHICAGO.
Shepley, Rutan & Coolidge, Architects.

Among the staff of instructors and lecturers on architecture, the genius of Mr. Louis J. Millet is doing much to build up the school. His classes in original design show some remarkable work, although some might criticize their being too entirely "Sullivanesque" in style. The designs are carried into the "Room of Application" and very instructive work done in modeled ornament. Capital, spandrels, polychromatic friezes (reminders of the Transportation Building at the Fair) are modeled in clay, and even mosaic work is designed and executed by the young architects.

The magnificent new Art Institute building, designed by Shepley,

Rutan & Coolidge, and the splendidly equipped Armour Institute together should make a home for a great school of architecture. May it exert a powerful influence on the architecture of the West.

PHILADELPHIA. — Within the few years just passed several of the best architects of this city have made some brilliant successes in the use of the common "run of kiln" bricks. In many instances these were used inclusive of the blackened arch bricks, and even in some instances of the greater proportion of the darker material, the lighter and more regularly burned being excluded. These architects understood their business, however, and designed for the materials they were to use; the result has been a pronounced success, as is shown by the imitations which are being thrust upon the public by those less skilled in the use of the material; indeed, it has taken the fancy of the public to such an extent that demands have been made upon the speculative builder for dwellings of this material; and the builder has seized with eagerness the opportunity thus given him to use the cheaper material for his fronts and charge more for the job than if he had used the best quality of pressed bricks. He argues that of course the fronts are very "artistic," and if the people want them this way they must pay for it. The public in general would not suffer from this transaction, were it not for the fact that within the scope of the "artistic" are some of the meanest and most despicable designs (if they may be called by that name) that have ever been executed in this city, renowned for its bad architecture. There was at least a certain neatness in the brick and marble fronts which had previously been built, even if their detail was of the worst and their composition empty and monotonous; but this only qualification is lacking in the "artistic" fronts, while the would-be Italian balconies, executed in galvanized iron and shingles, and the ever-present and badly proportioned loggia of the same order, combine to make this latest acquisition to Philadelphia architecture the worst that it has ever seen. Happily, however, there is arising in the city a class of architects who have been well educated into the principles of the profession, who are not merely plan machines, and whose offices are not plan factories; better still is the fact that these architects have been receiving and executing commissions from the best classes of clients, and are thus able to show the public the real difference between that which really is artistic and the other thing. Any number of good architects, with no commissions to execute, would be powerless to educate a community which can be educated, artistically, only through the sense of sight; it is, therefore, very gratifying to note that their works are being duly appreciated, and that the time is quickly approaching when the word "artistic" will have to mean something more than showy or glaring. We are beginning to fear that the time is approaching for some persons to retire from business.

St. James Hall, which will shortly be given into the hands of the contractors, will add another to the fine terra-cotta buildings of the city. It will be situated at the corner of Thirty-Eighth and Market Streets, and will be for the use of the St. James Parish. The first floor contains the necessary entrance lobbies and four storerooms fronting on Market Street; the second, a large assembly hall and the necessary anterooms; the third has rooms for the meetings of the societies connected with the parish, reading, chess, and billiard rooms, and smaller rooms for the meetings of special committees. The entire fourth floor is given over for use as a gymnasium, to which is attached lavatories, baths, and showers for the use of the members; and a wide balcony, forming the fifth floor, will be used as a running track. The exterior is in the style of the French Renaissance, is quite rich in detail and very liberally ornamented with terra-cotta and diaper patterns in brick. The architects, Messrs. Rankin & Kellogg, have devoted very much study to the various parts of the work, and especially the designing of it, and have succeeded in producing a building of which they may well feel proud.

A final scheme for the new Museum of Archæology, which will be built in the near future, has been adopted, and the architects are busy with the working drawings. The building will be very large and will rival anything of a similar nature in the country. The architects who have been commissioned for the work are three well-known firms,— Wilson Eyre, Jr., Frank Miles Day & Bro., and Cope & Stewardson. We expect to be able to give the details of the operation in the near future.

Under the date of June 3, 1895, the Master Stone Cutters' Association of this city have issued the following: "At a regular stated meeting of the Master Stone Cutters' Association held this evening, the following resolution was adopted: *Resolved*, That we will not estimate on any job of cut stone work that is a less scale than one fourth of an inch to one foot, and the secretary be directed to notify all architects in Philadelphia and vicinity."

Quite a suicidal policy to adopt just at the time when there is a great deal of very large work upon the markets and the terra-cotta companies are pushing their material against cut stone whenever an opportunity presents itself.

Plans are being prepared by Architect Huston for the ten-story publication house and office building for the Presbyterian Publication Society. It will cover an area of 75 x 235 ft., and will be located on the corner of Walnut and Juniper Streets.

PITTSBURG. — Building is very lively at present, as there is talk of a rise in prices on materials, which most of the investors are taking advantage of; although many business rooms and houses are vacant, many new operations are under way.

Ground will be broken at once for the new family hotel to be erected on Fifth Avenue, from Neville to Craig Streets, costing $2,000,000. The building is to be of fire-brick and red terra-cotta trimmings in Spanish style of architecture.

Mr. G. D. Simen has plans well under way for a large store and office building to be erected on Grant Street. It will be twelve stories high, and it is intended that this shall be the most imposing structure on the street.

Architect S. A. Barr has plans for a seven-story stone and brick office building to be erected in the East End; it is to have all modern conveniences and a roof garden.

Architect J. E. Allison has plans for a brick and stone church to be erected at Venice, Washington Co., Pa.

According to report, McKeesport is to have another hotel, which will cost $500,000 or more. A Pittsburg capitalist is interested in the scheme.

A new building ordinance was introduced into councils last week. It is one prepared by a committee, consisting of councilmen, architects, contractors, the building inspector, and the fire marshal. The ordinance applies to all buildings, except churches, hereafter to be built in the city over 60 ft. in height, measuring from the curb opposite the center of principal front to the highest point of roof. They shall be constructed after the manner known as "slow burning and fire-proof construction."

The term "slow burning" applies to all buildings other than hotels, theaters, assembly rooms, schoolhouses, hospitals, tenements, and lodging-houses over 60 ft. and less than 90 ft. in height, and of wood, and prescribes the dimensions of the timber to be used in beams, girders, joists, floors, etc.

The term "fire-proof" applies to all buildings over 90 ft. in height and built of incombustible material,— terra-cotta, brick, plaster, or iron, or metal, lath and iron, concrete, or steel, — and specifies the thickness of the covering for the several materials.

After the passage of the ordinance it shall be unlawful to construct any schoolhouse or hospital over one story in height, hotel or lodging house containing over thirty sleeping-rooms, unless after the manner provided in the class known as fire-proof, and any building destroyed can only be rebuilt as so provided.

Regulations are made for elevators, moldings, partitions, stairways, roof, boiler-rooms, bulkheads, tanks, skylights, etc.

BUFFALO.—There have been remarkable changes in the architectural history of Buffalo during the past year; not in the quantity of buildings erected, but the quality and vastness of the structures.

The daily papers have spread the impression of great activity here in building; this is quite erroneous, being principally real estate puffs and schemes, looking well upon the drawing-board, but not architectural realities.

The chief cause for the large buildings which are or have been erected is no doubt due to the expectations developed by the electric power at Niagara Falls.

Such investments are made principally by Eastern capitalists.

Below will be found mention of some of the larger buildings:—

Bank of Commerce: two stories; gray granite with red tile roof.

Delaware Baptist Church: cost $100,000; John H. Coxhead, architect; built of brown Medina sandstone.

Bank of Buffalo: R. W. Gibson, architect, New York; three stories; gray granite and cream terra-cotta, cornice and roof.

D. S. Morgan Building: cost $350,000; Green & Wicks, architects; twelve stories high; first two stories gray granite; remainder, gray brick, Sayre & Fisher make, with terra-cotta cornice and belt courses by Perth Amboy Company.

George B. Mathew: six stories; brick and steel store, in Flemish design, costing $90,000.

DETROIT.—Transactions in the building line have been very active, considering that the season is now well advanced into that period when business gives place to recreation and the volume of trade becomes lessened; still, notwithstanding that the month just passed was rather a quiet one in the architects' offices, Fire-Marshal Baxter this last week granted permits to the amount of a million dollars, being ten per cent. more than any previous week.

A few of the buildings which help to make up this favorable report are described below.

The Public Library, of which Detroit can well afford to be proud, is to have an extensive addition built of pressed brick and terra-cotta; this will make it a more comfortable and complete institution than that of any other city of the same size.

Wm. S. Joy is preparing plans for three elegant apartment houses, each to be six stories in height; up to the second floor will be bluestone, and the remaining stories of buff pressed brick.

The new Central High School building, designed by Architects Malcolmson & Higginbotham, is completed to the top of the basement windows.

Few enterprises have had a more trying career in development or a more satisfactory termination than the building of this high school.

The extreme dimensions of the building are: length, 307 ft.; depth, 232 ft. The total height is 233 ft., costing $400,000.

Plans have been commenced for several very important structures, which will be described in this column as soon as the drawings shall be sufficiently advanced.

COLUMBUS.—Yost & Packard report plans just completed for a new church edifice, to be known as the church of St. Francis. The structure will be of pressed brick with stone trimmings, designed in the Romanesque style, and will cost about $20,000.

Stribling & Co. report plans completed for an electric light plant and apartment house to be erected in this city. The foundations will be of Delaware Limestone, and the walls of terra-cotta brick from the Columbus Brick & Terra-cotta Co. The window architraves will be of gray molded brick.

The basement floor is to be given to the electric plant, and the three floors above will be divided into flats.

Messrs. Spielman & Elliott have dissolved partnership. Mr. Spielman will continue in the former offices of the firm, while Mr. Elliott will open an office in the Wheeler Building.

Mills & Goddard have completed plans for a fine residence for Mr. J. F. Dickinson. The building will be of pressed brick with bluestone trimmings. The plainness of the brick walls will be relieved by special details of ornamental brick patterns.

The same firm have completed drawings for a residence for Mr. J. H. Newton, of Newark, Ohio. The house will be built entirely of hollow tile of terra-cotta, all walls being thus made hollow. The wall ornamentation, window architraves, etc., will be of special molded terra-cotta forms. Even the foundation walls, porch foundations, and steps will be of terra-cotta. The main walls will be laid in broken range; the roof will be of terra-cotta tile. The interior of the house will be fitted with all modern conveniences.

AMERICAN ENAMELED BRICK.

IN view of the fact that enameled brick is coming rapidly into a much more general use in this country, we give herewith the results of tests made by Prof. Ira M. Woolson, Columbia College, New York, for the Pennsylvania Enameled Brick Co. This test is particularly important in view of the fact that if English size bricks are laid in the wall to the height of 100 ft., the lower courses in said wall are obliged to carry about 2,500 lbs.

EMERY HYDRAULIC TESTING MACHINE.

ENGINEERING DEPARTMENT, SCHOOL OF MINES, COLUMBIA COLLEGE, NEW YORK CITY.

Results of tests made for Pennsylvania Enameled Brick Co., Oaks, Pa., by Ira M. Woolson, E. M.

	Source			Pennsylvania.
	Material			White glazed brick.
	Test No.	1210	1211	1213
	How Tested	Pressure parallel to glazed surface.		
	Shape, Original			English size brick.
	,, of test piece	Cube.	Cube.	Cube.
Dimensions:	Length or height in inches	1.888	1.880	1.875
	Diam. or breadth in inches	1.88	1.89	1.88
	Thickness in inches	1.89	1.87	1.87
	Area in square inches	3.55	3.53	3.51
Stress in pounds. Compression.	First Crack		15,808	
	Maximum on specimen	14,600	15,800	15,500
	,, per square inches	4,112	4,475	4,415

REMARKS.

No. 1210. Cracks came in body of the specimen. Glaze did not scale.

No. 1211. About ½ sq. in. of glaze flew off at 15,800 (first crack). After crushing, glaze adhered to broken fragments. In no case did glaze crack off until specimen failed.

This company, which is one of the largest manufacturers of American Enameled Brick, has, since 1891, sold more than 6,000,000 bricks. Some of the more prominent jobs that we call to mind being the

Power House, Niagara Falls . McKim, Mead & White, architects.
Power House, Metropolitan Traction Co., Houston Street and Broadway, New York . . . McKim, Mead & White architects.
Power House, Metropolitan Traction Co., Twenty-fifth Street and Lexington Avenue, New York . Wm. Schickel & Co., architects.
St. Vincent's Hospital, New York . Wm. Schickel & Co., architects.
Mail and Express Building, New York, Carrere & Hastings, architects.
S. P. C. C. Building, Twenty-Third Street and Fourth Avenue, New York . . . . . Renwick, Aspinwall & Renwick, architects.
Mohawk Building, New York . . . W. H. Robertson, architect.
Storage Warehouse, Rose and Duane Streets, New York, Wm. H. Russell, architect.
Reception Hospital, E. Sixteenth Street, New York, Chas. S. Warner, architect.
Abbey's Theater, New York . J. B. McElfatrick & Son, architects.
Drexel Institute, Philadelphia . . Wilson Bros. & Co., architects.
Reading Terminal (Twelfth Street Entrance), Philadelphia, Wilson Bros. & Co., architects.
Betz Building, Philadelphia . . . . Will H. Decker, architect.
Broad Street Station, P. R. R. Co., Philadelphia, Furness, Evans & Co., architects.

The Bourse, Philadelphia . . . . . Hewitt Bros., architects.
Y. M. C. A. Building, Chicago . . Jenney & Mundie, architects.

Architects and builders who were at one time prejudiced against American bricks, on account of the repeated failures of different concerns in their attempts to manufacture enameled bricks in America, are now specifying and using the product of the Pennsylvania Enameled Brick Company's works, much to their satisfaction, which is attested by the facts as shown above.

Theirs is a mud brick, enameled in one burning, the body of the brick and the enamel being a heterogeneous mass, and they make the positive statement that their enamel will not peel off, no matter what test may be applied. Their bricks have successfully withstood the freezing test, which is considered the most severe that can be applied, also the most severe natural test, which is exposure to the weather for a number of years in a climate where changes from heat to cold and vice versa are numerous and sudden.

These bricks have been highly recommended for use in hospitals on account of the enamel not having a glassy finish, and, therefore, will naturally reflect the greatest amount of light; also, on account of their sanitary advantages, being non-porous, and, therefore, proof against disease germs, and it being possible to wash them thoroughly with hose or sponge. The works of the company are situated at Oaks, Pa., and, although very extensive, are devoted entirely to the manufacture of enameled brick.

THE CELADON TERRA-COTTA COMPANY.

CHARLES T. HARRIS, who has for some time past represented the Celadon Terra-Cotta Company, of Alfred, N. Y., at Chicago, has taken a lease of the plant, patents, property, and goodwill of the company, and will have the management of the whole business in his hands. He has associated with himself Will R. Clarke, formerly secretary to the Celadon Company, who will have charge of the New York office.

The Chicago office is removed from the Medinah Temple to the new Marquette Building, at the northwest corner of Dearborn and Adams Streets, and will be in charge of Henry S. Harris, formerly of Minneapolis, a brother of Charles T. Harris.

The Celadon Company has hitherto produced the finest examples of roofing-tile manufactured in this country; among them we may instance a particular favorite, the "Conosera." Now that Mr. Harris is no longer merely associated with, but has control over the whole concern, we anticipate that his special technical knowledge and art training, coupled with remarkable business capacity and ample means, will ensure great progress for the industry at Alfred Center.

THE NEWMAN BUILDING, J. Pickering Putnam, architect, in process of erection at the corner of Commonwealth Avenue and Berkeley Street, Boston, is equipped throughout by the Fawcett System of Fire-proofing.

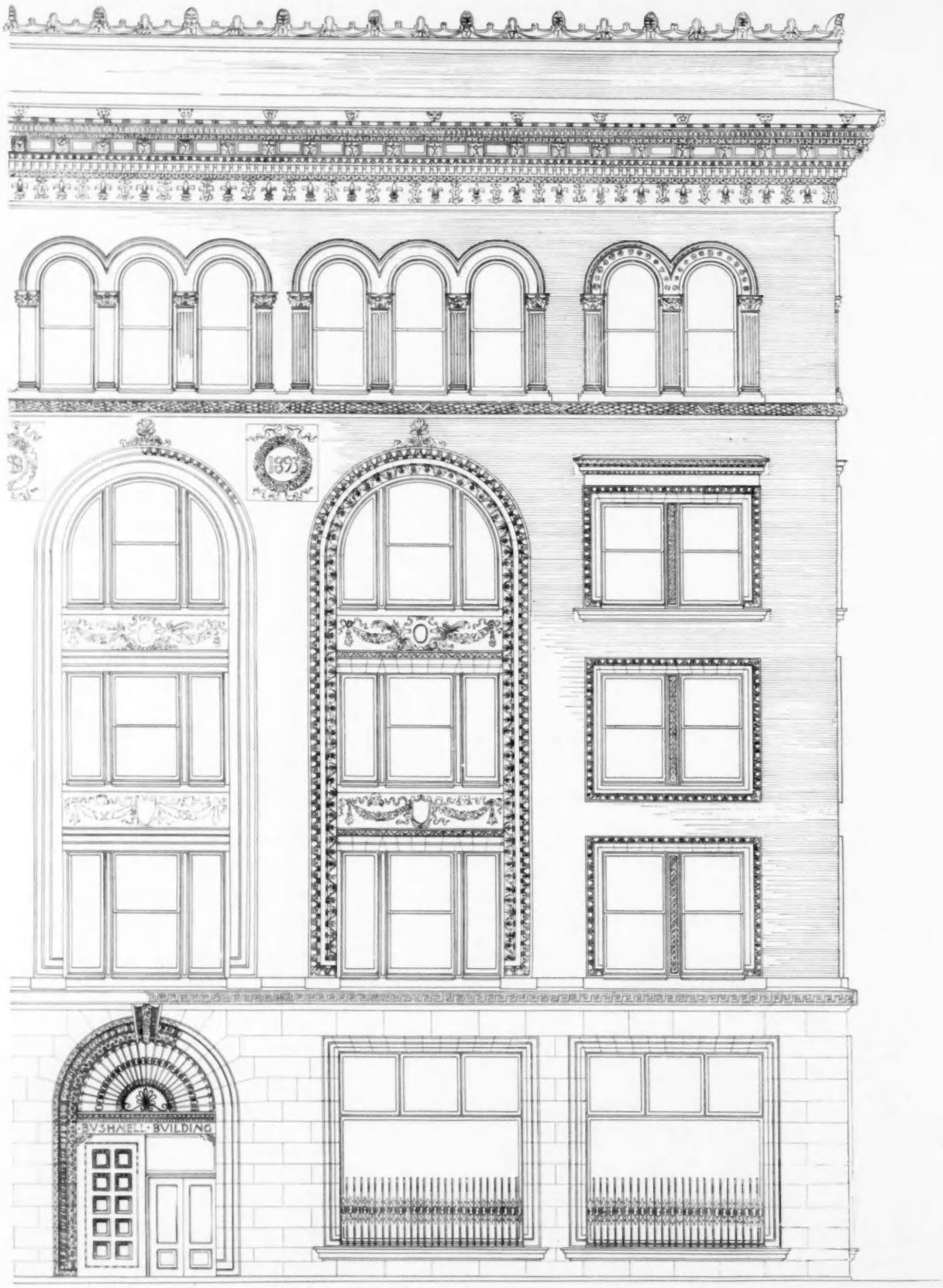
THE contracts for furnishing the enameled brick for the new Atwood Building, Chicago, and the Guaranty Building, Buffalo, have been awarded to the Tiffany Pressed Brick Company.

WE take pleasure in calling attention to the neat catalogue just issued by J. W. Penfield & Son, Willoughby, Ohio, on Dry Press Brick Machinery. The catalogue opens with a brief article on the mode of operation in making a dry press brick; then follows a general description of their machinery adapted to this work. This is supplemented by several cuts of their latest improvements in two, three, and four mold presses. The catalogue is very handsomely designed, and combines much information with an attractive appearance.

WANTED.

WANTED — A man well acquainted with the selling of front brick, to act as general salesman and have charge of other salesmen and agents, for a large brick manufacturing concern. Address, giving age, experience, and references: Salesman, — Care THE BRICKBUILDER PUBLISHING CO., Boston, Mass.

WANTED — Modelers, pressmen, and finishers on terra-cotta work. Apply to the White Brick and Terra-Cotta Company, 92 and 94 Liberty Street, New York.



SCALE –

OFFICE BVILDING FOR GEN A S BVSHNELL SPRINGFIELD OHIO

SHEPLEY RVTAN & COOLIDGE ARCHITECTS

BOSTON CHICAGO ST LOVIS

HARVARD UNIVERSITY
CONANT HALL

SHEPLEY RUTAN & COOLIDGE
ARCHITECTS
BOSTON MASS

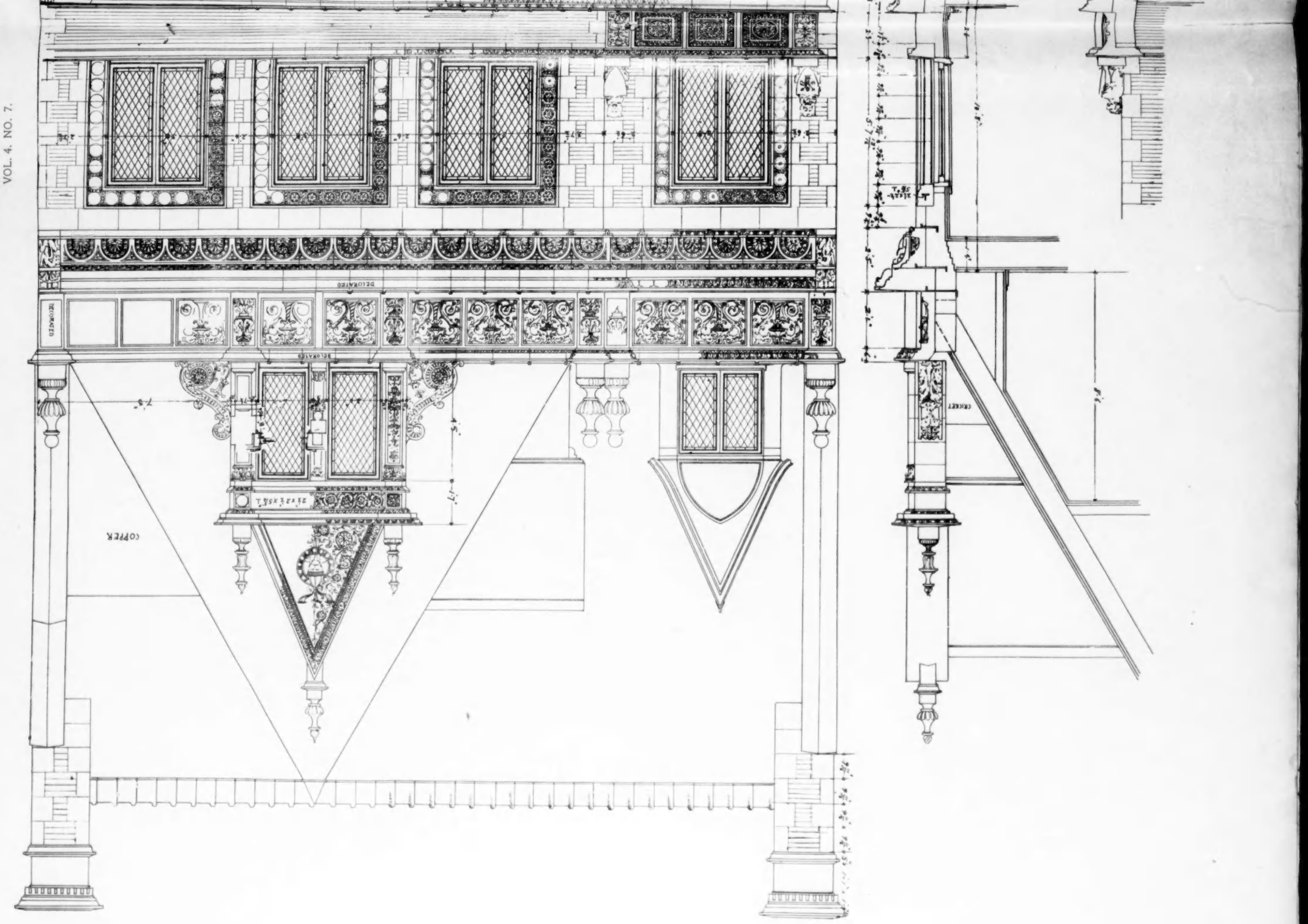

DECORATED
DECORATED
COPPER
CEMENT

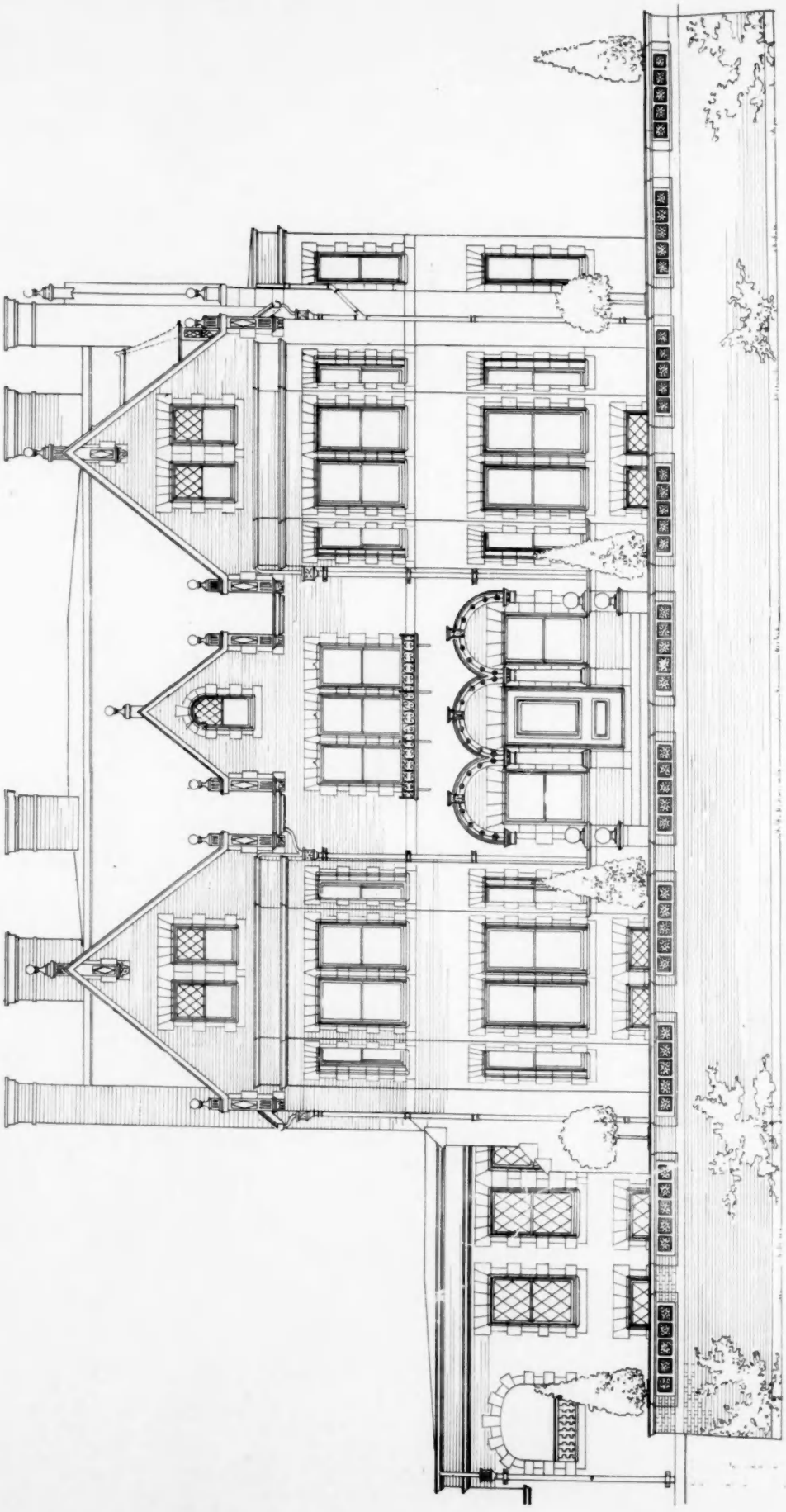
PLATE 47 AND 48.

A HOUSE AT WASHINGTON, D. C.

FACADE ALL TERRA-COTTA.

SHEFLEY, RUTAN & COOLIDGE, Architects

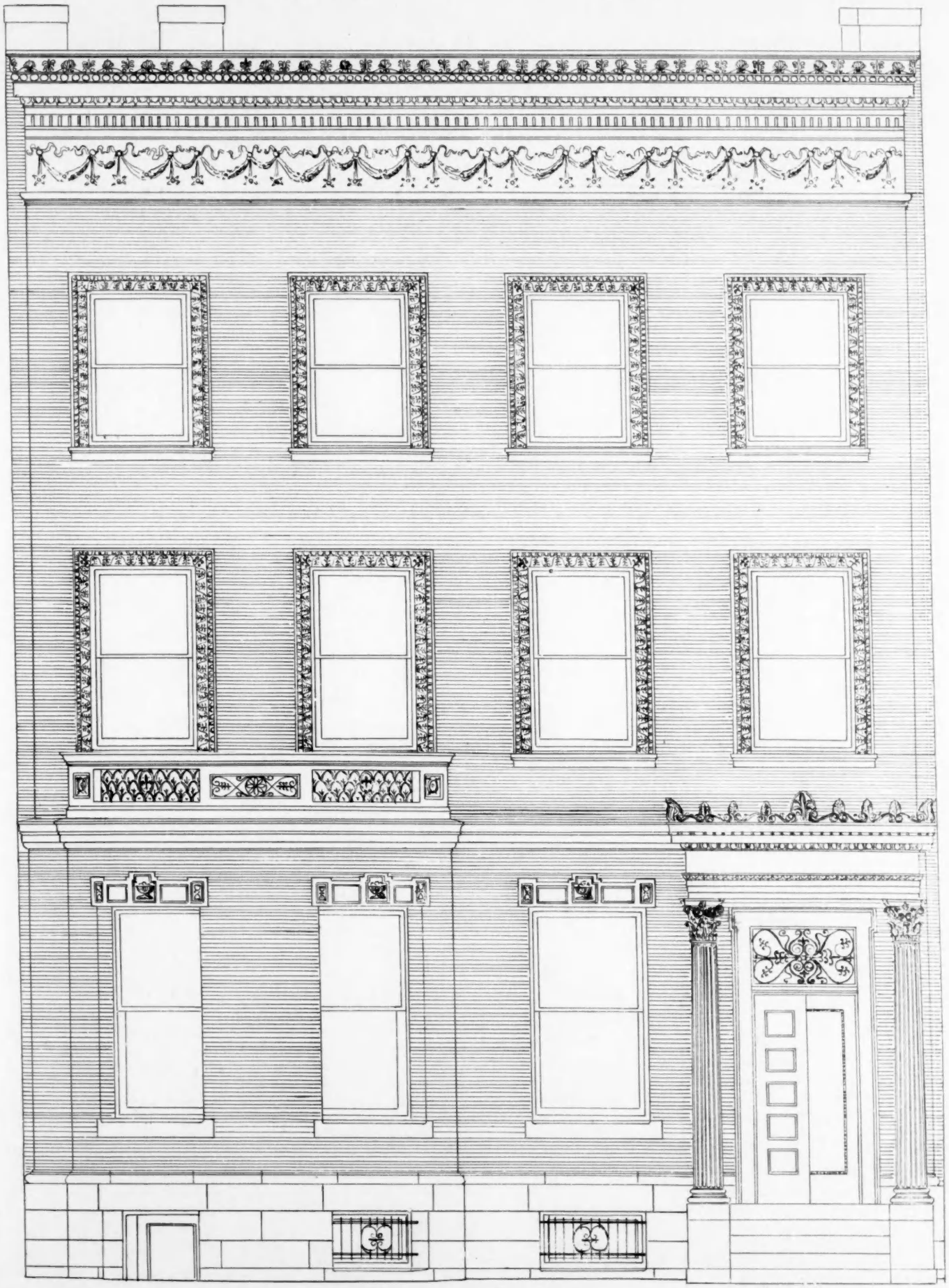
BOSTON. CHICAGO.



HOUSE FOR J. H. WHITE, ESQ., BROOKLINE, MASS.

SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS.

BOSTON. CHICAGO. ST. LOUIS.



RESIDENCE OF WM. DICKINSON, Esq., Chicago.

SHEPLEY, RUTAN & COOLIDGE, Architects.

BOSTON. CHICAGO ST. LOUIS.